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## REPORT OF A CASE OF SARCOMATOSIS CUTIS, TOGETHER WITH AN ANALYTICAL STUDY OF FIFTY OTHER CASES COLLECTED FROM THE RECENT LITERATURE.

By J. C. Wilson, A.M., M.D., and Frederick J. Kalteyer, M.D.,
of Philadelphia.

The following case observed in the medical service of the Jefferson Medical College Hospital during the past winter is placed upon record, because it illustrates one of the varieties of disseminated malignant disease involving alike the viscera and the skin. The opportunities for the clinical study of this disease during part of its course and for the investigation of the cutaneous lesions were ample, but circumstances rendered a post-mortem examination impracticable:

*Pigmented mole upon the forehead; rapid growth after injury, with great vascularity; removal by operation, followed by the formation of a normal scar; the appearance about the time of the operation and shortly afterward of disseminated nodules in the skin and subcutaneous tissues; rapid irregular enlargement of the liver; enlargement of the spleen; rapid wasting; fatal termination.*

Mrs. M. B., aged twenty-six years; occupation, housewife; birthplace and residence, Pennsylvania.; admitted into the Jefferson Medical College Hospital, December 27, 1902; discharged January 13, 1903.

*Family History.* The patient's mother, father, four sisters, and one brother have been in excellent health. Two paternal aunts died of consumption. Some years ago her father suffered from a tumor of the face situated just beneath the eye, which was successfully removed by operation, and subsequently manifested no signs of recurrence. The patient could give no further details concerning this growth.

*Personal History.* During childhood the patient had measles, chickenpox, and whooping cough, and since these illnesses, until the present

trouble began, she enjoyed fairly robust health. Menstruation was established at the age of seventeen years; the periods, which lasted from four to nine days, have always been irregular and painful. On December 6, 1901, she was married, and in May, 1902, gave birth to a child after a difficult labor. There was laceration of the perineum, which was immediately repaired. The child, which was fed upon the breast until a few weeks prior to the patient's admission into the hospital, appeared to be healthy.

Since childhood the patient had a small pigmented mole on her forehead. It was injured during the spring of 1901, by a blow against a hard object, producing slight contusion of the mole and the circumjacent tissues, but as the injury only caused temporary discomfort the incident attracted no special attention. A short time afterward the mole began to grow rapidly; it became exceedingly vascular, and on numerous occasions it bled; sometimes after a slight jar of the head or by rubbing of the forehead. On one occasion an attack of vomiting brought on a profuse hemorrhage from its surface. The tumor was dark purple, of soft texture, pediculated, hung over the left eyebrow, and measured 5 or 6 cm. in its longest diameter. Early in June 1902, it was excised. Healing was slow and at this time there was some evidence of recurrence in the granulating wound, which disappeared after the application of some caustic preparation. A small nodule made its appearance just in front of the tragus of the left ear before the primary growth was removed. During August, 1902, she complained of pain referred to the left side of the abdomen and lower thorax, and later of pain in the opposite side, where it was constant and severe at the time of admission to the hospital. The illness progressed rapidly, and for the greater part of the two months prior to admission she was confined to her bed on account of general weakness. During this period her appetite was greatly impaired, she often vomited after taking food, her bowels were constipated, and she lost at least twenty-five pounds in weight. For a few weeks prior to her admission she was unable to urinate, which necessitated the use of the catheter.

About ten days before entering the hospital a number of small nodules appeared over the surface of the body; some were confined to the skin, some to the subcutaneous tissues, while others were more deeply situated.

*Physical Examination.* The patient presented signs of extreme emaciation. The skeletal development was normal. She was exceedingly nervous, a condition which, under observation, was subsequently found to be due to a craving for opium. The fact that she was in the habit of taking opium was not known to the patient or the attending physicians of the hospital for several days. She became quite comfortable upon the administration of heroin, the nervousness disappearing almost entirely.

On the left side of her forehead, 3 cm. above and nearly parallel with the eyebrow, there was an elongated, slightly depressed reddened scar about 4 cm. in length, marking the site from which the original growth was removed. There were scattered irregularly over the surface of the body, hemispherical, oval, and roundish nodules, varying in diameter from a few millimetres to a centimetre (a few exceeded this size), situated cutaneously or embedded in the subcutaneous tissues with freely movable skin over them. These tumors were slightly tender to

the touch, of rather firm consistence, and presented no evidences of inflammation. Twenty-five nodules were found on the anterior surface of the thorax and abdomen, this being the area of densest distribution. The back, neck, and extremities showed numerous nodules, and a few were present upon the face. Over the seventh rib posteriorly on the left side a neoplasm was found attached to the periosteum, and over the ensiform cartilage there was a large nodule, the skin over which showed slight bluish discoloration. (Fig. 1.)

FIG. 1.

Disseminated sarcomatous nodules of the skin.

The liver was irregularly enlarged and tender; its lower margin extended to about four fingers' breadth below the costal arch in the right midclavicular line; its anterior surface was markedly uneven. The hepatic enlargement produced broadening of the base of the chest and marked abdominal distention, the right hypochondriac and epigastric regions being especially prominent. The rise and fall of the liver

on inspiration and expiration could be plainly made out through the thin abdominal wall, and stomach peristalsis was also visible. The spleen was somewhat enlarged. The axillary and cervical lymphatic chains were not palpable, but the inguinal glands were slightly enlarged. The heart and lungs appeared normal.

A urine examination made on December 29, 1902, gave the following results: Quantity in twenty-four hours, 570 c.c.; color, amber; transparency, clear; specific gravity, 1020; reaction, acid; urea, 2.2 per cent.; albumin, a trace present; sugar, not present; melanin, present.

*Microscopic Examination.* Amorphous urates and squamous epithelium.

A blood examination made on December 29, 1902 showed: erythrocytes, 4,490,000 per c.mm.; leucocytes, 2800 per c.mm.; hæmoglobin, 90 per cent.; color index, 1.0 per cent. Differential count: polynuclear neutrophiles, 90 per cent.; large lymphocytes, 1 per cent.; small lymphocytes, 7 per cent.; eosinophiles, 2 per cent.

On admission irritability of the stomach was a prominent symptom; the patient vomited frequently after taking nourishment or medicines, therefore, feeding by the mouth was discontinued and nutritive enemata consisting of an egg, peptonized milk and whiskey, were given three times daily. With this treatment the vomiting subsided and the patient was subsequently fed by the mouth. One grain of sodium cacodylate and one-twelfth of a grain of heroin were administered by the mouth three times a day. The patient was catheterized at eight-hour intervals.

On December 31st the patient's consent was obtained to the removal of one of the nodules for microscopic study; a small tumor of the skin of the left thigh was excised. This growth was rather firmly attached to the fascia covering the muscle; it was soft and had a dark bluish color.

*Report of the Histological Examination of the Tumor.*

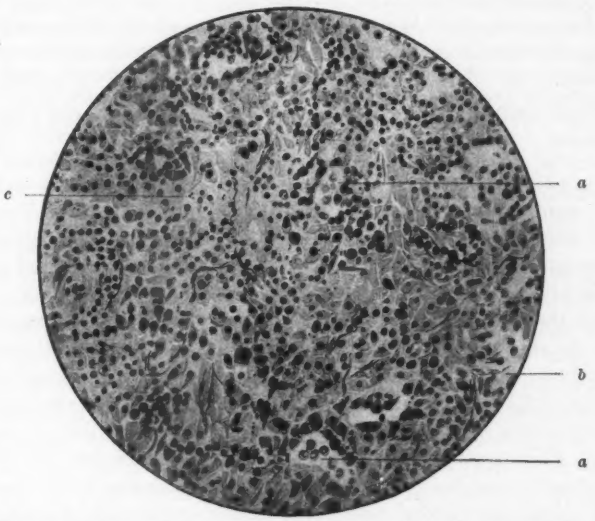
The tumor excised from the leg was examined in the laboratories of the Jefferson Medical College Hospital by Professor Coplin. The following is an abstract of his report:

The specimen submitted for examination consisted of two small, irregularly ovoid fragments of soft tissue, grayish-pink in color, measuring, respectively, 0.5 cm. by 6 cm. by 3 cm. by 4 cm. They were fixed in a saturated alcoholic solution of bichloride of mercury, dehydrated and hardened in alcohol, infiltrated and embedded in paraffin and sectioned. The sections were stained by the usual laboratory methods. (Fig. 2.)

Histologically, the sections consisted almost entirely of cells with a small amount of intercellular reticulum of fibrillated connective tissue. The cellular elements varied greatly in size; the smallest measuring from 6$\mu$ to 8$\mu$, and the largest from 18$\mu$ to 20$\mu$. All intermediate gradations were observed. The shape of the cells also varied—some were oat-shaped, a few were spindle formed, but most of them spheroidal. Some of the cells had a relatively large nucleus bounded by a faintly staining or extremely narrow zone of protoplasm, which in many instances was granular.

With respect to the tinctorial peculiarities of the cells, some of the nuclei stained intensely, almost black; such nuclei, when not showing mitoses, were usually tinged uniformly. Other nuclei reacted faintly, the chromatin appearing fragmented or dotted here and there, inside of what appeared to be a nuclear membrane. Many of the cells exhibited mitotic figures; the greater number of these were atypical. The periphery of the perinuclear protoplasm of many of the cells was indefinitely outlined.

FIG. 2.




Section of tumor. Report No. 2058. *a a*. Blood channels walled by tumor cells and containing a few erythrocytes. *b*. Small strands of connective tissue; similar fibroids are scattered irregularly throughout the field. *c*. Pigment granules; other particles of pigment can be seen between the cells at a number of points. The extreme variations in size, shape, and relation between nuclear and protoplasmic bulk and differences in tinctorial reaction are conspicuous throughout the section.

Fine, irregular, yellow and yellowish-brown granules were scattered here and there throughout the sections examined. The distribution of this pigment was so inconstant that no effort was made to determine its microchemical character. Mast-cells were not present in the tumor, but were found in a narrow, irregular zone of fat bordering one of the margins of the tumor. The periphery of the tumor could be outlined with a fair degree of sharpness; in some areas crowding of the cells and adjacent structures was a conspicuous feature, but at no point was there any indication of a tumor capsule.

There were distributed throughout the cell mass numerous spaces lined with tumor cells; which evidently represent the channels through which the neoplasm received its blood supply.

*Diagnosis.* Spindle-cell sarcoma.

On January 4th (eight days after admission) at least a dozen new nodules had made their appearance over the abdomen, and about five or six on the back.

On January 10th hepatic dulness extended downward in the right midclavicular line to a point one finger's breadth below the level of the umbilicus, and in the median line to the umbilicus. Tenderness over the liver had increased. The spleen had increased in size, its dulness extending two fingers' breadth below the edge of the ribs. Slight impairment of pulmonary resonance was elicited below the left clavicle.

On January 13th the patient returned to her home. A communication received from her physician stated that she died on February 24th.

After returning to her home the disease made rapid progress; the liver continued to enlarge; there was a great increase in the number of nodules over the body; œdema of the extremities showed itself, and, just prior to her death, the lower extremities became paralyzed. The physician also noted that some of the tumors ulcerated and a few disappeared.

The malignant melanotic growths arising from pigmented moles or nævi were considered by all writers as sarcomatous, until Unna, in 1892, disputed this view and claimed that they were of epithelial origin. Unna maintains that pigmented tumors springing from nævi are of epithelial origin, and that the nævus cells are really epithelial cells, which during the embryonic period or in the first year of life are snared off from the epidermis. The researches of Gilchrist, Waelsch, Kromayer, and others confirm this view. Many pathologists, among whom may be mentioned Bauer, Green, Hansemann, Ribbert, and Lubarsch, do not support Unna's contentions, and most systematic writers on dermatology, while seemingly in favor of accepting the conclusion of Unna, still classify these neoplasms under the general heading of sarcomatosis cutis. From the clinical standpoint, however, this form of malignant disease is practically identical with the generalized melanotic sarcoma springing from the choroid. Recently Johnston reported an interesting case of perithelial sarcoma of the armpit, followed by disseminated growths in different parts of the body, which developed after injury of the forearm at the site of a pigmented nævus. This author writes that "it is not safe to generalize to the extent of saying that all neoplasms arising from nævi are carcinomata." This mooted question remains a problem for future research.

Our case undoubtedly belongs to the so-called generalized melanotic sarcoma, or to the so-called nævocarcinoma, although the almost complete absence of discoloration of the skin overlying the nodules, and the scanty distribution of melanotic pigment in the tumor examined, suggest that it approaches a border-line type between the generalized melanotic and the generalized non-pigmented sarcomata. The clinical aspects of the case are typical of those described in the literature as generalized sarcoma, in which malignancy follows a nævus tumor.

The interest this case aroused suggested a review of cases in the recent literature described under the general designation of a multiple sarcoma of the skin, and the results of this investigation form a part of this communication. These cases have been analyzed and tabulated, with the view of determining the relative frequency of the different varieties and to ascertain some of the clinical features in a series of fifty cases. The wide range of their clinical manifestations, the variations from the generally recognized typical types, which are by no means infrequent, their obscure etiology, and the complex and diverse pathological views entertained by different authorities on the subject of sarcomatosis cutis, render classification most difficult. The cases have been arranged in the following three groups: (1) multiple melanotic sarcomata; (2) multiple non-pigmented sarcomata; and (3) multiple, pigmented, hemorrhagic sarcomata.

Twenty-six per cent. of the cases belong to the group of multiple melanotic sarcomata of the skin, 26 per cent. to the second group, the multiple non-pigmented sarcomata, and 48 per cent. to the third group, multiple, pigmented, hemorrhagic sarcomata.

In the melanotic group the youngest subject, in which the age was reported, was twenty-one years, the oldest sixty-five years, and the average forty-three years and nine months. Sex does not appear to have any marked predisposing influence; males were attacked more often than females in the proportion of about six to four. With respect to the situation of the primary growth, no part of the body seems especially susceptible. Of great interest, however, is the fact that in 69 per cent. of the cases the primary growth had its origin in a mole or nævus, and in some of these traumatism of the mole seemed to act as an exciting cause. Eves recently analyzed the record of melanosarcoma in the London Hospital during a period of twenty years and found 45 cases, of which 33 occurred in the skin; out of this number 26 began in pigmented moles, and he points out that in a few cases a history of irritation by scratching of a mole was obtained. In our tabulated cases of melanotic sarcoma mention is made of enlargement of the lymphatic nodules in six cases, or in about 46 per cent. The prognosis of multiple melanotic tumors of the skin is highly unfavorable, and the duration of the disease comparatively short. It was impossible to determine the exact length from the histories of the cases studied, as many were reported during the progress of the illness; the shortest course was measured by a period of weeks, while in the longest duration death occurred after a period of ten years; the average duration slightly exceeded three years. Eves found the average duration of life in melanoma in his series between two and three years, and sometimes prolonged as long as ten years.

GROUP I.—MULTIPLE MELANOTIC SARCOMATA.

| No. | Reporter. | Age and sex. | Diagnosis. | Primary seat. | Metastasis. | Lymphatic glands. | Duration. | Termination. | Treatment. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G. S. Whiteside | F. 50 | Melanosarcoma. | Right foot, from a mole. | Two nodules in the skin near cicatrix; internal organs involved. | ..... | About a year and a half. | Death. | Amputation of the foot. | |
| 2 | A. H. Tubby | M. 65 | Multiple melanotic sarcoma. | Scrotum. | Left half of the lower jaw; liver enlarged; many nodules over whole body in skin and subcutaneous tissues. | Lymphatic glands of neck and groin enlarged. | Over eight weeks. | ..... | ..... | Tumors grew rapidly; lymphocytosis present. |
| 3 | Hensen and Nolke | M. 21 | Melanotic sarcoma. | Neck, from pigmented mole. | Nearly all organs involved. (Uniform brownish black pigmentation of the skin.) | ..... | Over a year. | Death. | Primary tumor excised. | Inoculation of rabbits with tumors excised at autopsy did not produce sarcoma nor pigmentation of skin. |
| 4 | Waelsch | F. 56 | Melanotic sarcoma. | Over right shoulder-blade, from a mole. | Metastasis to the skin near growth. | Slight enlargement of maxillary lymphatics. | ..... | Unfavorable course. | ..... | Author holds that tumor was of epithelial origin belonging to melanotic carcinomata. |
| 5 | Waelsch | M. 40 | Melanotic sarcoma. | Abdomen, from a mole. | Skin of trunk and extremities. | Inguinal lymphatic glands enlarged. | ..... | ..... | ..... ..... | Author holds that tumor was of epithelial origin belonging to melanotic carcinomata. |
| 6 | T. C. Gilchrist | M. 58 | Melano-carcinoma. | Tumor sprang from pigmented mole on right foot. | Metastasis to the skin and subcutaneous tissues of the legs, arms, and trunk; head, neck, and mucous membranes of eyes, mouth, and nose were normal; some of the growths ulcerated. | No glandular enlargement. | About six years and a half. | Death. | Fowler's solution had no influence on course of disease; excision of primary growth was followed by recurrence. | Injections of sterile bouillon containing small fragments of a tumor into a dog did not produce tumor formation. |
| 7 | Waelsch | M. 30 | Melano-sarcoma. | Chest, from a pigmented mole. | Secondary tumors formed around primary growth. | ..... | Ten years. | | | |
| 8 | Ludwig Merk | ... | Sarcoma with melanotic pigmentation. | Over right shoulder-blade. | Metastatic deposits of varying size, and some showing ulceration, developed in different parts of the body; nodules were greatly discolored. | | | | | |

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| 9 | Bark | F. 50 | Melanotic sarcoma. | Back. | Many tumors in the skin near primary growth. | ..... | Over a year. | After excisi'n of primary tumor patient developed general melanosis; death occurred 3 months after operation. | | |
| 10 | Bozzolo | F. 47 | Disseminated sarcoma. | From a mole. | Every organ contained sarcomatous nodules. | ..... | Short duration. | ..... | ..... | Author states that brain contained many tumors, but that during life there were no sensory or motor symptoms. |
| 11 | U. A. Minie | M. 27 | General melanotic sarcoma. | Over right shoulder-blade, from a mole. | Multiple tumor formation in skin and subcutaneous tissues in many parts of the body; tumors had an alveolar arrangement; some of the cells contained melanin. | Enlargement of lymphatic glands near primary growth. | About five years. | Death from septicæmia following extirpation of some of the nodules. | Arsenic and potassium iodide had no influence. | |
| 12 | Giovanni Pini | F. 25 | Nævosarcoma, fusi cellulari. | Left loin from pigmented nævus. | Skin, abdomen, and subcutaneous tissues: sarcoma cells found in the kidneys, mesenteric glands, but none in the liver or spleen. | ..... | Sixteen months. | Death. | Opium, arsenic, and bismuth. | |
| 13 | Rona. | M. 57 | Melanosarcoma, multiplex cutis. | Left inguinal gland enlarged 4½ yrs. ago, and 1 yr. before date of report nodules formed over right buttock. | Neoplasms appeared over many parts of the body; densest distribution upon feet and forearms; face, extremities, and mucous membranes of lips and mouth show brownish discoloration; spleen enlarged. | Cervical lymphatic glands enlarged. | Over a year. | | | |

GROUP II.—MULTIPLE NON-PIGMENTED SARCOMATA.

| No. | Reporter. | Sex and age. | Diagnosis. | Primary seat. | Metastasis. | Lymphatic glands. | Duration. | Termination. | Treatment. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | Ransohoff | F. 12 | Generalized non-pigmented sarcoma (round-cell). | Tumor on right cheek spread rapidly to lower lid. | In three weeks disseminated nodules covered the surface of the whole body, mucous membrane of the mouth, and subcutaneous tissues; internal organs apparently not involved. | Superficial lymphatic glands enlarged. | Short. | Death from diphtheria. | Fowler's sol. in ascending doses, followed by marked improvement; many tumors disappeared, but others developed. | |
| 15 | Kuschen | M. 33 | Generalized non-pigmented sarcoma. | Whole body covered with nodules (300). | ..... | ..... | ..... | ..... | Arsenical treatment did not check disease. | |
| 16 | M. Kaposi | M. 52 | Multiple sarcoma of the skin with involvement of internal organs. | Numerous nodules in the skin which existed for 6 wks. before patient came under observation. | Disseminated nodules in the skin, muscles, lymphatics, dura mater, myocardium, right suprarenal, pleura, peritoneum, liver, rectum, and right testicle. | ..... | Brief duration; about two months. | Death. | Arsenic without influence. | |
| 17 | Strauss | M. | Multiple sarcoma of the skin and stomach. | Skin. | Stomach and skin. | ..... | ..... | ..... | ..... | Author regards skin as primary seat. |
| 18 | Max Joseph | M. 32 | General sarcomatosis (clin. diag.), histologically not a typical sarcoma. | Non-painful tumor in epigastric region. | About 100 nodules over the surface of the body, also metastasis to the omentum, mesenteric glands, œsophagus, and intestine. | Lymphatic glands enlarged. | ..... | Death. | ..... | Author regards his case as belonging to the group of sarcoid tumors. |
| 19 | Spiegler | M. 55 | Sarcomatosis cutis (mixed round and spindle-cell sarcoma). | Right thigh. | Numerous small nodules developed in the neighborhood of the primary growth; internal organs appeared normal. | ..... | ..... | ..... | Injections of streptococcic cultures did not benefit patient. | |
| 20 | Karewsky | Newborn. | Angiosarcoma. | ..... | Entire surface of body covered with small white tumors; tumors grew rapidly in four months without impairment of the child's general health. | ..... | ..... | ..... | ..... | After excision of one of the nodules recurrence occurred rapidly; histological examination revealed an angiosarcoma; a threefold temporary leucocytosis present; author suggests that the sarcoma had its origin in the adventitia of the bloodvessels. |

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| 21 | Rille | M. 64 | Multiple non-pigmented skin sarcoma. | Loin. | Numerous nodules developed upon the skin; the upper lip contained a nodule; internal organs were normal. | ..... | One year. | ..... | For a few days pills of arsenic and hæmoglobin. | About 100 nodules scattered over body, some in the skin, others in the subcutaneous tissues; all were covered with normal skin. |
| 22 | W.W.Iwanoff | F. 22 | Multiple skin sarcoma. | Abdomen; a number of nodules appeared upon the abdomen. | Autopsy revealed new growths in the skin and subcutaneous tissues, biceps muscle, inguinal glands, liver, stomach, small and large intestines. | Inguinal glands enlarged. | ..... ..... | Death; disease progressed rapidly. | Bismuth subnitrate for gastrointestinal disturbance; arsenic and morphine. | Author divides the disease into two stages: the first of 2 mos. duration, during which multiple skin sarcoma developed (small round-cell sarcoma); the second period lasted 2½ weeks, in which the skin affection was not the conspicuous feature, but there was marked fever, hemorrhages, vomiting, diarrhœa, nephritis, and then lobar pneumonia. He regards the latter part of the disease as a septic manifestation. |
| 23 | Kriebick | M. 38 | Alveolar sarcoma. | Upon back in dorsal region in median line. | Tumors developed in the skin and subcutaneous tissues of trunk and of the left axilla. | ..... | ..... | ..... | Tumor excised twice, each time rapidly re-forming. | Author states that the tumor was rich in cells showing an alveolar arrangement and histologically represented a border-line between sarcoma and carcinoma. |
| 24 | Kaposi | F. 76 | Lymphosarcoma. | ..... | Skin and internal organs; at first metastatic growths rapidly formed in the skin of buttocks and extremities, which in the course of 2 weeks disappeared almost completely; later, however, disseminated nodules developed in the skin and the internal organs. | ..... | Short. | Death. | | |
| 25 | Krulle | F. 51 | Round-cell sarcoma. | First nodule between shoulders, then tumors developed near site of primary growth. | Disseminated nodules in the skin over entire body, also in subcutaneous tissues. | ..... | Six years. | Favorable. | Arsenical treatment. | Internal organs normal. Author regards prognosis as favorable. |
| 26 | Johnston | ... 47 | Sarcomatosis cutis, perithelial sarcoma. | Arm; from pigmented mole; patient injured the forearm at the site of a pigmented nævus, 2 years before coming under observation; 2 months later tumor developed in armpit, and 10 months later neoplasms formed on the arm. | Disseminated nodules in the skin over whole body; two of these nodules on examination were found to be fibromata; tumor in abdomen. | Axillary lymphatic glands enlarged. | About two years. | ..... | ..... | Author states that it is not safe to generalize to the extent of saying that all neoplasms arising from nævi are carcinomatous. |

## Group III.—Multiple Pigmented Hemorrhagic Sarcomata.

| No. | Reporter. | Sex and age. | Diagnosis. | Primary seat. | Metastasis. | Lymphatic glands. | Duration. | Termination. | Treatment. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | Unna | M. 75 | Hemorrhagic sarcoma. | Tips of fingers of the left hand. | Left foot. | ..... | ..... | ..... | Ascending doses of arsenic with progressive improvement. | |
| 28 | Robert Bernhardt | M. 25 | Sarcoma idiopathicum multiplex. | Left foot. | Metastasis to the left leg, tissues about the knee-joint; skin and other parts of the body normal; atrophy of the muscles of the left leg; bones of the foot are not affected; internal organs normal. | Left inguinal glands slightly enlarged. | Seven or eight years. | Hypodermic injections of arsenic were first given, later arsenic in pill form without influencing local disease; amputation of foot. | Recovery. | All the tissues of the foot were involved by the sarcoma; the author places this case in the group of idiopathic multiple pigmented sarcoma of the skin. This case is particularly interesting because there are certain points of difference in both the clinical and pathological aspects from the type described by Kaposi (multiple pigment sarcoma). The nodules showed a tendency to infiltrate the tissues; the lymph vessels were greatly broadened. He suggests the name of sarcoma idiopathicum multiplex en plaques pigmentosum et lymphangiectodes. |
| 29 | Spiegler | M. 48 | Idiopathic multiple pigment sarcoma. | Hands and feet. | | | | | | |
| 30 | Philippson | M. 70 | Multiple idiopathic sarcoma of the skin. | ..... | ..... | ..... | Two years. | ..... | ..... | Autopsy revealed carcinoma of the lungs, liver, kidneys, spleen, and serous membranes. |
| 31 | Kaposi | M. 58 | Sarcoma, multiplex pigmentosum | Sole of foot; hemorrhagic discoloration of sole of foot; induration, swelling, and discoloration developed. | Upon the hands and other parts of the body. | ..... | Five years. | ..... | Under arsenical treatment some of the nodules disappeared. | Hemorrhages occurred from the lungs and nose. |

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| 32 | Scholtz | M. 51 | Multiple idiopathic skin sarcoma. | Upon both feet. | Developed upon hand and other parts of the body, upper and lower extremities, mucous membrane of the gums, also involved bones of foot. | ..... ..... | Five years. | Favorable course followed amputation of foot. | Arsenical treatment had no effect upon the disease. | Microscopic diagnosis—sarcoma. |
| 33 | Lustgarten | M. 65 | Multiple idiopathic pigmented sarcoma (Kaposi.) | Upon extremities, particularly upon the fingers and toes. | ..... | ..... | Over two years. | ..... | Arsenic hypodermically. | Microscopic examination revealed a spindle-cell sarcoma. |
| 34 | G. Dieballa | ... | Multiple idiopathic sarcoma. (Kaposi.) | ..... | ..... | ..... | ..... | ..... | ..... | Marked increase in the leucocytes involving particularly the mononuclear forms. |
| 35 | Robert Bernhardt | M. 52 | Pigment sarcoma. | Radial side of left hand; onset marked by reddening and thickening of the skin. | Left foot and hand, then upon various parts of the upper and lower extremities, also nodules on the trunk; tumors yellowish-red in color, firm, and varied in size from that of a pinhead to that of a hen's egg. | Left inguinal glands enlarged. | ..... | ..... | ..... | Internal organs normal. Microscopic examination revealed a pigment sarcoma composed of spindle-cells and some oval and round cells; the tumor was very vascular. |
| 36 | Robert Bernhardt | M. 50 | Angiosarcoma. | Upon the feet; tumor formation preceded by discoloration and thickening of the skin. | Bright red nodules developed on the ankles; palate also involved. | Not enlarged. | Over two years. | ..... | ..... | Internal organs normal. |
| 37 | Sequeira | M. 65 | Multiple pigmented sarcoma. | Two years before patient came under observation dark purple discoloration of skin of inner side of right ankle appeared; later tumors developed in this region and at same time an eruption appeared upon left hand. | Left hand, feet, and other parts of extremities became involved; right hand and arm not involved. | ..... | Over two years. | ..... | Arsenic appeared to have no effect. | The tumors were soft and vascular; histologically, growths in many respects resembled an inflammatory swelling. |

| No. | Reporter. | Sex and age. | Diagnosis. | Primary seat. | Metastasis. | Lymphatic glands. | Duration. | Termination. | Treatment. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| 38 | Gustav Tandler | F. 12 | Multiple sarcoma of the skin. | Small soft tumors simultaneously developed upon both hands. | Upon the arms. | Glandular enlargement absent. | Over one year. | Marked improvement; disappearance of some of the nodules. | Arsenic. | Internal organs normal. |
| 39 | Spiegler | ... | Multiple idiopathic sarcoma. (Kaposi.) | Skin of upper and lower extremities contained bluish nodules. | ..... | ..... | ..... | ..... | ..... | Author points out that this form of sarcoma may pursue a favorable course and the tumors decrease in size, leaving atrophied areas of skin; the internal organs are exceptionally involved; the differential diagnosis between this variety and the more malignant forms must be made upon clinical grounds as the histological differences are slight. |
| 40 | Wolters | M. 23 | Hæmangiosarcoma cutis. | Left cheek. | Other parts of the body; tumors showed reddish discoloration. | ..... | Over one year. | Improved after short course of treatment. | Arsenic injections. | Tuberculin injections failed to give a local or general reaction. |
| 41 | Kaposi | M. 52 | Sarcoma cutis idiopathicus multiplex. | On back of left hand; bluish-red discoloration of hand. | Nodules upon both hands and lower extremities; reddish discoloration with induration. | ..... | Over two years. | | | |
| 42 | Antonio Stravino | M. | Generalized hemorrhagic sarcoma. | Developed in a scar upon foot. | Upon the leg, then upon the opposite limb, and later upon upper extremities. | Lymphatic glands enlarged. | ..... | ..... ..... | ..... | Internal organs normal; histologically tumor found to be a vascular small round-cell sarcoma; author suggests the possibility of an infectious origin. |
| 43 | A. Roth | ... | Idiopathic multiple sarcoma. | | | | | | | |
| 44 | Robert Bernhardt | M. 70 | Spindle-cell sarcoma. | Right foot. | Upon the left foot, then upon the hands. | Inguinal lymphatic glands enlarged. | Five or six years. | ..... | Right foot was amputated. | Nodules situated upon discolored skin; some nodules ulcerated; internal organs normal. |

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| 45 | Robert Bernhardt | M. 86 | Multiple hemorrhagic sarcoma. | Hands and feet. | Upon the extremities, penis, and scrotum. | ..... | Exact onset not known; duration estimated as being five years. | | | |
| 46 | Robert Bernhardt | M. 25 | Multiple hemorrhagic sarcoma. | Head. | Upon feet and left leg. | Cervical and submaxillary glands enlarged. | ..... | ..... | ..... | Some nodules ulcerated; internal organs normal; illness progressive, some nodules increased in size and new ones formed. |
| 47 | Robert Bernhardt | M. 69 | Multiple hemorrhagic sarcoma. | Right foot. | Upon right leg, left foot, and hands. | ..... | ..... | ..... | ..... | Skin in the involved areas showed bluish discoloration; during course of disease patient became emaciated. |
| 48 | Robert Bernhardt | M. 59 | Multiple hemorrhagic sarcoma. | Left hand. | Left and right foot, also left upper eyelids; skin of involved area thickened, indurated, and discolored. | ..... | Five years. | | | |
| 49 | Kaposi | M. 51 | Sarcomatosis cutis. | Numerous nodules of a brownish-red color upon left calf. | Scrotum and shoulder. | Lymphatic glands enlarged. | ..... | Death. | Arsenic without effect. | Histological examination revealed a sarcoma. |
| 50 | C. Boeck | M. 56 | Multiple benign sarcomatosis of the skin. | On forehead. | Spread to face, trunk, arms, forearms, thighs, and legs; nodules varied in size from that of a pinhead to that of a bean, were rather firm; some had a bluish tint and showed slight umbilication. | Enlargement of many chains of lymphatic glands. | About seven years. | Recovery considered complete by the author. | Prolonged treatment with arsenic and cod-liver oil. | Neoplasms atrophied and sclerotic changes developed; the cells of the new-growth were of epithelioid connective-tissue type; true giant cells of the sarcomatous type were present. |

The treatment of multiple melanotic sarcoma is most unsatisfactory. Early surgical interference was practised in several of the cases studied without apparently influencing the rapid metastasis which followed, although many instances can be found in the literature which demonstrate that early excision of the primary growth is not followed by recurrence. Whiteside reported a case of melanosarcoma in a female, aged fifty years, which had its origin in a mole on the right foot, in whom amputation was performed without preventing subsequent metastasis, but he nevertheless holds that radical surgical interference should be practised early in such cases. He advances the following conclusions: (1) a mole on the foot in a middle-aged person should be excised; (2) an ulcer beginning in a mole on the foot demands immediate and radical surgery; (3) the prognosis of ulcerated moles should be guarded even where the growth seems non-malignant. Potassium iodide, arsenic, and other drugs of the so called alterative group have been tried without effect.

Inoculation experiments were unsuccessful. Hensen and Nolke inoculated rabbits with melanotic tumors excised at autopsy without subsequently producing sarcoma or pigmentation of the skin, and Gilchrist injected sterile bouillon containing fragments of a sarcomatous nodule into a dog without causing subsequent tumor formation.

The multiple, non-pigmented variety shows variable clinical and pathological features. In the above tabulated cases the average age of the patients is between thirty-nine and forty years. A case was found in which it occurred in the newborn, and one as late as seventy-six years. Males were attacked more frequently than females in a proportion of about two to one. The primary seat in some cases was cutaneous, in others subcutaneous. In about 30 per cent. of the cases the lymphatic glands were enlarged. Nothing definite can be said of the rapidity with which metastasis develops; the internal organs were involved in some cases, while in others they were apparently healthy, with extensive cutaneous dissemination, nor can a definite opinion be formed of the duration, as in some of the cases the date of the onset could not be determined, in others the reports were made while the disease was still in progress, and in two death resulted from other causes. In some of the cases the duration of the disease was short, with a fatal issue, while in others it existed for a few years, and in one as long as six years. Regarding the treatment the administration of arsenic was, as a rule, without influence, although in a few cases this drug appeared to have a favorable effect.

The third group—multiple, pigmented, hemorrhagic sarcoma—has attracted much interest, and also represents a form of varied symptom-complex. Its pathology is even less definite than that of the other two varieties. The tumor formation usually begins upon the extremities,

and may attack the dorsal surfaces or the soles of the feet, backs or palms of the hands, then spread to other parts of the extremities, and may finally involve the trunk, face, and mucous membranes, and exceptionally the internal organs; not infrequently several parts of the body are attacked simultaneously or at short intervals. The tumors usually show bluish-red discoloration, and the circumjacent skin of the involved area is usually swollen, indurated, and discolored. In a case reported by Bernhardt the sarcomatous process involved nearly all the tissues of the foot.

The course of the disease is variable, lasting several years and sometimes prolonged as long as five years or seven years, and may ultimately end in recovery. This form of malignant disease is generally regarded by writers as sarcomatous, although many eminent dermatologists oppose this view. In a case recorded by Sequiera the histological examination in many respects resembled an inflammatory swelling, and Stravino suggests the possibility of an infectious origin. The prognosis is not so grave as in the two other forms; Bernhardt and Scholtz report cases which terminated in recovery after amputation. Treatment with arsenic appears to have a favorable influence in modifying the course of the disease, and in some cases recovery has followed. In our tabulated cases of multiple, pigmented, hemorrhagic sarcoma, the average age of the patients is fifty-three years, the youngest subject being twelve years, the oldest eighty-six years. Sex seems to have a predisposing influence, as males are attacked much more frequently than females. Of twenty-one of our cases in which the sex was noted twenty were males.

In conclusion, we wish to direct attention to the great danger that a mole may take on active growth, and be transformed into a malignant tumor by traumatism at its site, such as scratching, slight contusion, or cutting, and, finally, to the importance of early radical surgical interference in those cases in which tumors spring from pigmented moles.

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## UNCINARIASIS IN TEXAS.[1]

By Allen J. Smith, M.D.,
Professor of Pathology, University of Pennsylvania.

(From the Pathological Laboratory of the University of Texas, 1903, No. 6.)

Introductory. Some years since the writer, interested in consequence of having frequently met with various human parasites in the work of the Pathological Laboratory of the University of Texas, elicited from the venerable Ferdinand Herff, of San Antonio, in the course of a conversation concerning his experience with parasitic worms, a number of interesting data upon the subject, and later had the pleasure of inducing Dr. Herff to publish these experiences. In one of his articles,[2] Dr. Herff refers to his having met certain small round worms in the intestine of a Mexican woman who had died in his care, which, at the time of the autopsy, he had regarded as young ascarides, and had neglected in consequence, but which at the time of writing he was disposed to believe, as he recalled the specimens, to have been examples of *uncinaria duodenalis*. In 1895 (by mistake stated 1893 in the article of Dr. M. C. Schaefer in *Medical News*, October 26, 1901, and quoted

[1] Read in Section of Medicine, American Medical Association, New Orleans, 1903.
[2] Trans. Texas State Medical Association, 1894; Texas Medical Journal, June, 1894.

thence by Stiles and others), while demonstrating in class the microscopic features of fecal matter (obtained from the common closet of the college and supposed to be normal), the writer encountered ova which at first, from ignorance of the subject, he supposed to be those of *oxyuris vermicularis*, but which after further study at the time were determined as those of *uncinaria duodenalis*. Although what at the time was believed a reasonable effort was made to discover the host of the worms, the search was not successful. A number of times during the following years in the intestines of experiment dogs the writer came upon examples of the allied species *uncinaria canina*, and was inclined to believe that the prevalence of the latter could be regarded as suggesting fit conditions in the same locality for prevalence of the human species. Moreover, in several instances he had found peculiar small ecchymotic wounds in the upper part of the small intestine of human beings at autopsy, similar to those found in dogs which have been infested by hookworms, from which again the suspicion of human uncinariasis arose; and, although the worms were not found in these particular instances, this failure may easily be understood when it is stated that in the routine autopsy work the unopened intestines were formerly always handed over to a laboratory servant, to be opened and washed before examination was made of the interior appearances, under which circumstances it is quite likely that any parasites present were unnoticed and washed away. Finally, in 1901, in a case in the United States Marine Hospital Wards in St. Mary's Infirmary under the care of Acting Surgeon William Keiller, Dr. M. Charlotte Schaefer, while examining the stools for *amœba coli*, encountered certain bodies which she brought to the writer for identification. They were recognized as the ova of the hookworm, and after Dr. Keiller, with this knowledge in his possession, had administered a suitable dose of thymol, followed by salts, there were obtained from the discharges a few more than one hundred examples of the worm. This case[1] has been reported by Dr. Schaefer.[2] Within a day or two after this discovery (the ova from this case having in the meantime been demonstrated to the medical class) the class was working over some presumably normal human fecal matter taken from the common closet of the school, when several of the students called the attention of the demonstrator in charge, Dr. William Gammon, to the existence of the same ova in this specimen, and on investigation they were found in large numbers

[1] The parasites from this case are in possession of the writer and have been identified as examples of *uncinaria americana*. It is of interest to add that in this case not only were the above-mentioned ova met with, but also a number of eggs of the whipworm and numerous *amœbæ coli*. Subsequently one male *trichocephalus dispar* was obtained from the stools, but no more at any time. At autopsy some months later a small, shrivelled hydatid cyst was found in the liver, and in the lungs and pericardium advanced tuberculosis.

[2] Trans. Texas State Medical Association, 1901; Medical News, October 26, 1901.

in a large proportion of the class preparations. After this discovery the writer posted upon the college bulletin board an announcement of the fact and its importance, indicating the particular apartment of the closet and the approximate time of the deposit of the feces therein, and asking that any of the students recalling the use of this apartment at about the stated time should communicate with him. Several persons thus applied, and microscopic examination of their passages was made, but without discovery of any of the ova. These occurrences took place in the latter part of February, 1901. In the latter part of the following month it happened that with this positive knowledge of the existence of the parasite in the intestines of at least one or more of the students the writer noted a distinct eosinophilia in the blood of two students who, among others, applied at this time for examination for the parasite of malaria, and was led thereby to suggest examination of the stools for the possible discovery of these parasites as a complication in each case. In the feces from each of these cases (Cases I. and II.) the ova of the hookworm were found, and in the blood of the first the malarial organism was also afterward encountered by the writer; but, unfortunately, the latter gentleman almost immediately left school without notice to the writer, and the discovery of the ova was not followed by the removal of the parasites themselves. The second was, however, presently given thymol, and the worms obtained in the stools passed thereafter.

These two instances of the discovery of the hookworm in persons living practically all their lives in Texas, and hence having acquired the parasite from conditions prevailing in the State, together with the other data above mentioned, caused the writer to undertake the examination of the stools of as many of the students in the school as could be induced to submit specimens to him. It was thought that the group of medical students coming from many portions of the State would serve in an unusual degree as an index of the population of the State, and the discovery of the parasites in persons whose homes were widely distributed would establish in an unquestionable manner the prevalence of the worm as a native entozoon of this general district of the country. In the search thus undertaken the writer was materially aided by the following gentlemen, then members of the Junior Medical Class, whom he wishes here to thank for their assistance: J. J. Terrill, W. A. Allison, J. R. Elliott, D. H. Lawrence, O. H. Plant, C. D. Cantrell, and M. R. Sharp. With the co-operation of these gentlemen the writer was able, between May 7 and June 12, 1901 (the latter date being the time of finishing the final class examinations in the school and the time when the undergraduates, as a rule, left Galveston), to examine with a fair degree of care eighty-six examples of feces submitted by as many individuals (inclusive of a few previously examined by the writer).

In this group of eighty-six individuals eight persons were found to be infested with hookworms; and doubtless had it been possible to have extended the search throughout the entire student body, as at first planned, in the remaining one hundred and fifty or more, other instances would have been discovered.[1] It has been a matter of regret to the writer that he has been unable, because of imperative school duties, to supplement this original series by other investigations in the same systematic and a more thorough manner.

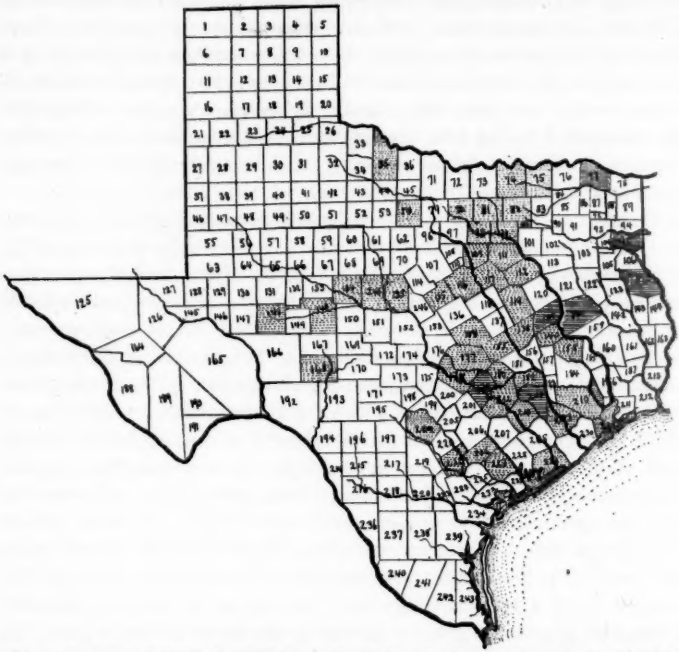
In addition to these, it is not improper to add at this date that several other cases have been recognized in the wards of the hospitals of Galveston by some of the colleagues of the writer, which will doubtless be published in the future, and that one case has been reported to the writer by Dr. J. S. Wooten, from Austin, Texas, and two cases by Dr. W. D. Jones, from Marshall. To date, as far as the writer is aware, these cases comprise those which have thus far been recognized from the State of Texas (from which the uncertain but probable case of Herff and the proved case of Dr. Schaefer should be excluded as being both of Mexican origin); but in the light of numerous discoveries of the parasite elsewhere in the United States, particularly following the brilliant investigations conducted by Dr. Charles Wardell Stiles,[2] zoölogist of the United States Public Health and Marine Hospital Service in the Carolinas and Georgia, these findings indicate the probability of a wide and important prevalence of this zoöparasite in Texas, and also in the general district of the South Atlantic and Gulf States.

Details of the Writer's Cases. The distribution of seven of the eight cases mentioned in the present series is indicated by the linear-shaded counties in the accompanying map of Texas (Fig. 1), the stippled counties representing the home counties of those students examined but not found infected. The eighth infested individual prior to his life in Galveston as a medical student has had no permanent residence for years; was originally from the western part of Louisiana, but had been employed in various occupations at various times in Texas, Louisiana, Indian Territory, Arkansas, New Mexico, Mexico, and Colorado. For this reason his home is not indicated in the map. In all the counties indicated as the homes of persons found to be infested the observation of Stiles (*sup. cit.*) that the disease is especially prevalent in sandy districts is well borne out. Red River County (77) is in the greatest portion sandy, with red clay subsoil, and its water

[1] It may be noted as a matter of further interest that in addition to the cases of uncinaria there were encountered in this series one case of *trichocephalus dispar*, one of *tænia mediocanellata*, eighteen of *amœba coli*, and eight of trichomonads and other infusoria.

[2] Bulletin 10, Hygienic Laboratory, United States Public Health and Marine Hospital Service, Washington, D. C.

FIG. 1.



Map of counties of Texas, showing by stipple shading the homes of persons examined for uncinaria ova but not showing same; showing homes of those infected by *uncinaria americana* by linear shading. Counties mentioned according to following list;

1, Dallam; 2, Sherman; 3, Hansford; 4, Ochiltree; 5, Lipscomb; 6, Hartley; 7, Moore; 8, Hutchinson; 9, Parnell; 10, Hemphill; 11, Oldham; 12, Potter; 13, Carson; 14, Gray; 15, Wheeler; 16, Deaf Smith; 17, Randall; 18, Armstrong; 19, Donley; 20, Collingsworth; 21, Parmer; 22, Castro; 23, Swisher; 24, Briscoe; 25, Hall; 26, Childress; 27, Bailey; 28, Lamb; 29, Hale; 30, Floyd; 31, Motley; 32, Cottle; 33, Hardeman; 34, Foard; 35, *Wilbarger;* 36, Wichita; 37, Cochran; 38, Hockley; 39, Lubbock; 40, Crosby; 41, Dickens; 42, King; 43, Knox; 44, Baylor; 45, Archer; 46, Yoakum; 47, Terry; 48, Lynn; 49, Garza; 50, Kent; 51, Stonewall; 52, Haskell; 53, Throckmorton; 54, *Young;* 55, Gaines; 56, Dawson; 57, Borden; 58, Scurry; 59, Fisher; 60, Jones; 61, Shackelford; 62, Stephens; 63, Andrews; 64, Martin; 65, Howard; 66, Mitchell; 67, Nolan; 68, Taylor; 69, Callahan; 70, Eastland; 71, Clay; 72, Montague; 73, Cooke; 74, *Grayson;* 75, *Fannin;* 76, Lamar; 77, RED RIVER; 78, Bowie; 79, Jack; 80, *Wise;* 81, *Denton;* 82, *Collin;* 83, Hunt; 84, Delta; 85, Hopkins; 86, Franklin; 87, Titus; 88, Morris; 89, Cass; 90, Rains; 91, Wood; 92, Camp; 93, Upshur; 94, Marion; 95, HARRISON; 96, Palo Pinto; 97, Parker; 98, *Tarrant;* 99, *Dallas;* 100, *Rockwall;* 101, Kaufman; 102, Van Zandt; 103, Smith; 104, Gregg; 105, Rusk; 106, Panola; 107, Erath; 108, Hood; 109, *Johnson;* 110, *Somervell;* 111, *Ellis;* 112, *Navarro;* 113, Henderson; 114, Comanche; 115, *Hamilton;* 116, *Bosque;* 117, *Hill;* 118, McLennan; 119, *Limestone;* 120, Freestone; 121, Anderson; 122, Cherokee, 123, Nacogdoches; 124, SHELBY; 125, El Paso; 126, Reeves; 127, Loving; 128, Winkler; 129, Ector; 130, Midland; 131, Glasscock; 132, Sterling; 133, Coke; 134, *Runnels;* 135, *Brown;* 136, Coryell; 137, Falls; 138, *Robertson;* 139, LEON; 140, *Madison;* 141, HOUSTON; 142, Angelina; 143, San Augustine; 144 Sabine; 145, Ward; 146, Crane; 147, Upton; 148, *Tom Green;* 149, Irion; 150, Concho; 151, McCulloch; 152, San Saba; 153, Lampasas; 154, *Bell;* 155, *Milam;* 156, Brazos; 157, Grimes; 158, *Walker;* 159, Trinity; 160, Polk; 161, Tyler; 162, Jasper; 163, Newton; 164, Jeff Davis; 165, Pecos; 166, Crockett; 167, Schleicher; 168, *Sutton;* 169, Menard; 170, Kimble; 171, Kerr; 172, Mason; 173, Gillespie; 174, Llano; 175, Blanco; 176, Burnett; 177, *Williamson;* 178, Travis; 179, BASTROP; 180, *Lee;* 181, Burleson; 182, *Washington;* 183, Waller; 184, Montgomery; 185, San Jacinto; 186, Liberty; 187, Hardin; 188, Presidio; 189, Brewster, 190, Buchel; 191, Foley; 192, Valverde; 193, Edwards; 194, Kinney; 195, Bandera; 196, Uvalde; 197, Medina; 198, Kendall; 199, Comal; 200, Hays; 201, Caldwell; 202, *Fayette;* 203, *Colorado;* 204, *Bexar;* 205, Guadalupe; 206, Gonzales; 207, Lavaca; 208, Wharton; 209, *Fort Bend;* 210, *Harris;* 211, Chambers; 212, Jefferson; 213, Orange; 214, Maverick; 215, Zavalla; 216, Dimmitt; 217, Frio; 218, La Salle; 219, Atascosa; 220, McMullen; 221, Wilson; 222, *Karnes;* 223, Live Oak; 224, Bee; 225, Goliad; 226, *Dewitt;* 227, *Victoria;* 228, Jackson; 229, *Matagorda;* 230, Brazoria; 231, *Galveston;* 232, Refugio; 233, Calhoun; 234, San Patricio; 235, *Aransas;* 236, Webb; 237, Encinal; 238, Duval; 239, Nueces; 240, Zapata; 241, Starr; 242, Hidalgo; 243, Cameron; 244, AUSTIN; 245, *Coleman;* 246, Mills.

supply is largely from surface wells; Leon (139), Bastrop (179), Harrison (95), and Shelby (124) counties may be similarly described (the last named has a small section of black river bottom land); the extreme east and west of Houston County (141) is black river bottom, the centre sandy, with red clay subsoil; the western and southern portions of Austin County (244) are black, approaching the "black waxy" type, its Brazos River bottom land is a red loam, its centre is sandy. All these districts depend mainly on surface wells for their water supply.

The eight cases included in the present series may be outlined as follows:

CASE I.—H., male, aged twenty-two years, medical student; has resided in Shelby County (124) all his life, save that for a year he worked on the H., E. and W. Railway between Houston, Texas, and Logansport, La., and after November 15, 1900, was in Galveston in attendance upon his medical course. At his home the water supply was invariably from surface wells; during his railway service it was from various sources; surface wells, springs, and creeks; since his residence in Galveston from deep artesian wells and from overground cisterns. There is no history of dirt-eating or other similar practises, and none of ground-itch. Within five years prior to the discovery of the hookworm ova in his discharges he had had no severe disease of any type beyond a number of malarial attacks, which invariably responded promptly to quinine. For about a year, however, he had noted more or less disturbance of an indefinite type in the abdomen, some irregularity of the bowel action, and slight discomfort in the upper portion of the abdomen. The patient first consulted the writer in the latter part of March, 1901, because of a malaria-like paroxysm the evening before. He was a sparely-built man, of medium height, anæmic in appearance, with a somewhat drawn, anxious expression, poor circulatory tone, no evidence of pulmonary disorder, no appreciated urinary fault, but complaining of moderate abdominal discomfort in addition to the history of the supposed malarial paroxysm. Examination of the blood at first failed to show the presence of hæmatozoa, the examination being made ten or twelve hours after the chill and the patient having had no quinine in the meantime. A distinct eosinophilia was, however, apparent, but no numerical determination of the red and white cells and no differential count of the leucocytes were made. The presence of the excess of eosinophile cells in association with the patient's appearance and with the failure to find the malarial organism in his blood led the writer to suspect that this man might be the individual from whom had been passed the hookworm ova found in the closet a few weeks previously, and a request for fecal matter was made. The following day, in a mushy, light-brown stool, the ova in question were quickly found in moderate numbers;[1] and a second blood examination made the same day resulted in finding a few ordinary tertian malarial parasites. Quinine in large doses was administered, and the patient was urged to submit to

[1] None of the parasites having been obtained from this case the precise type is unknown, but it may be inferred that they were, as in the others of the series, examples of *uncinaria americana* (Stiles).

medication with thymol, with a view of ridding him of the worms. This he declined, and the malarial paroxysms persisting in spite of the quinine, he shortly, without notifying the writer, left Galveston, and has never returned. Letters from him, however, state that after some time he recovered from the malarial attacks, but that his health continues to be far from good, the abdominal disturbances being persistent.

CASE II.—S., male, aged twenty-nine years; pharmacy student; home in Leon County (139), but prior to coming to Galveston to attend school he spent some months as a logger in a saw-mill in Angelina County (142). In the latter employment he was constantly handling dirty logs, and at this time was often forced to drink creek and "branch" water. At his home his drinking water was obtained from a surface well. Aside from the questionable water supply in Angelina County, no distinct dietetic faults were known. At no time in his life did he recall having had an eruption comparable to "ground-itch." While employed in Angelina County his health deteriorated to a marked extent; he lost not less than thirty pounds in weight, became decidedly anæmic, short-breathed, and much bothered with constipation. He had during this period no definite malarial attacks; but the day before he applied to the writer he had a severe paroxysm. At time of examination in March, 1901, he weighed about 170 pounds (probably ten or fifteen pounds less than his usual weight), was somewhat sallow, and complained of considerable malaise. Blood examination here again failed to reveal the presence of the malarial parasite; but, as in the former instance, a moderate eosinophilia was noted, and, for the same reason as in the previous case, a specimen of the patient's fecal discharge was asked for. The following day a small number of ova of the hookworm were discovered in the stool. Repeated examinations of the blood subsequently failed to show the presence of any malarial organisms; but early in the following vacation there was a second malaria-like paroxysm, after the subsidence of which the patient has remained to the present entirely free from this feature. On April 23, 1901, ninety grains of thymol were administered, with the usual precautions as to abstinence from alcoholics and oils, after a night's fasting, and followed by a dose of salts after an hour from the last dose of thymol. The stools were collected, washed through a sieve of cheese-cloth, and two female examples of the *uncinaria americana* (Stiles) were obtained. Owing to press of class work the writer was unable to give attention to complete blood study in the case, as was desirable, but put aside several smears for a differential leucocyte count. This latter shows an eosinophilia of 10 per cent., a marked increase of lymphocytes (40 per cent.), with a corresponding decrease in the polymorphonuclear elements (40 per cent.); large mononuclear cells, 8 per cent. There are to be seen in the specimens frequent examples of altered red cells and of polychromatia; apparently, too, judging roughly from both stained and fresh preparations of the blood there existed a distinct relative leucocytosis; but without exact method, it is, of course, unsafe to insist upon this feature.

Subsequent examination of the stools failed to exhibit the presence of more ova, and from the time of the discharge of these few worms, with the single exception of a chill and fever during the following vacation (for which quinine was at once given and which never recurred), the patient rapidly and fully regained his health and weight.

Although in this case so few of these worms were obtained that the writer has been forced to accept the idea that these could not have caused the symptoms mentioned above, yet it is to be kept in mind that possibly, by some fault in the collection or examination of the stools (which is not appreciated, however), a considerable number of the worms were lost. Or else it may be that the few actually found represented only the remnants of what was once a more serious number in the man's intestine. It seems not impossible that there may have been originally, probably at the time of the marked loss of flesh and the anæmia noted as having been present when the patient was working in Angelina County, a much greater number of the parasites than were obtained from the stools after thymol, and that the two actually found were the only ones remaining of such a really serious infection, and in this sense it is not improbable that much of the symptom-complex narrated may have been due to these parasites. At least the rapid and complete recovery of the patient's former health and vigor and the total disappearance of the abdominal discomfort after relief from these few worms would not be inharmonious with such an idea.

Case III.—G., medical student; aged twenty-one years; stockily built; sallow; a resident practically all his life in Red River County (77), working in the intervals of his school duties upon his father's farm and in a cotton gin. Three years prior to the discovery of the uncinaria ova in this case the patient had gone on a long wagon trip through the northern tier of counties of the State, west as far as Haskell County (52), thence northeast to Wilbarger County (35), thence along the Brazos River to Young County (54), and east in a somewhat tortuous route to his home—a trip of over 500 miles, during which time the water supply was uncertain and usually bad, taken from surface wells, ponds, creeks, and similar sources. At his own home the water supply was derived from cisterns, and in Galveston, since his first entrance into the medical school, from cisterns and deep artesian wells. Early in his life, from his ninth to his twelfth year, he had suffered from an obstinate diarrhœa, but had quite recovered from this, and for some years his health had been perfect. Since the Haskell County trip, however, he had noted continuously more or less abdominal disturbance: diarrhœa alternating with constipation, with occasionally small amounts of blood distinguishable in the feces, and usually more or less abdominal discomfort if not actual pain. In this case there is the history of the habit of chewing raw cotton in the gin when the patient was engaged at work in the gin, but nothing more nearly approaching the "dirt-eating" habit; there is no history of "ground-itch." During the summer and fall of 1900 (the year preceding the discovery of the parasites) the man was somewhat pale and weak, and because of the indefinite abdominal disturbance suspected the presence of intestinal parasites of some sort. During the same time there were occasional irregular paroxysms as from malaria, promptly ceasing upon the administration of quinine, but invariably reappearing if the drug was left off. This continued until in February of 1901, when the hæmatozoa were sought for and found without difficulty, and a persistent and thorough dosage with quinine was instituted, since when there have been no further disturbances of the sort. During this period, too, the patient noted the development of a shortness of breath and slight swelling about the ankles without any important change in the urine. On May 7, 1901, in the routine

examination of samples furnished by the class a number of hookworm eggs were found in the patient's feces; and on May 26th, after the administration of thymol, as in the preceding case, twenty-four examples of the *uncinaria americana* were obtained. Subsequent examination of the stools failed to show the presence of more ova; and to date of writing the patient, now a fourth-year medical student, has recovered entirely from all his symptoms, has increased markedly in weight, his color fully returned, all signs of circulatory and alimentary fault having entirely disappeared. A blood examination made at the time of examination, or shortly after, showed a decrease of the red cells to 4,100,000; white cells, 8000; hæmoglobin, 90 per cent. Unfortunately, the slide preserved for differential leucocyte count was mislaid, but there was a distinct but not very great eosinophilia evident.

The habit of cotton-chewing referred to in this case is mentioned because it is, perhaps, allied to the habit of dirt-eating noted in an important proportion of hookworm cases. It would give but little opportunity for belief in it as a means of transmission of the embryonic worms, which would surely be killed by desiccation if long in the dry cotton. The habit here is probably no more than a secondary pica, as the pica of chlorosis; and probably in many dirt-eaters the habit should be looked on in much the same light, although, according to the prevailing views as to the life-history of the parasite, it is possible, of course, that at times the habit may be the basis for actual transmission of the embryos to the human alimentary canal.

Case IV.—T., male; junior pharmacy student; aged twenty-one years; residence in Bastrop County (179), where he has lived continuously since birth, save that during his school vacations he has travelled over the greater part of the State, but has never been beyond the State limits. At his home the source of drinking water has been from a well sixty feet in depth; water calcic. Has had no important acute sickness for years prior to the discovery of the parasites in question, but has been subject to griping abdominal pains as long as he can recall (could never eat fruit, especially apples, in the evening without bringing on an attack of this sort, but would always find prompt relief from a little spirits of camphor). No chills for at least ten years; no diarrhœa. Three years before the discovery of the parasites he lost nineteen pounds in weight from some unknown cause within a period of two months, but regained the loss during the following winter. Eight or ten years prior to the time of discovery of the parasites his legs and ankles were frequently extremely painful, and often swelled; but these symptoms have not been noticed at all in recent years. Intestinal discharges were habitually firm; never noticed blood admixture. No dirt-eating habits; but the gentleman recognized the possibility of contamination of food from his dirty hands in the course of his farm work at home. There is no history of "ground-itch."

On May 8, 1901, numerous eggs of the hookworm were found, along with vast numbers of trichomonads, in the discharges of this individual in the course of the routine examination of samples submitted by the class; and on May 21, 1901, after the administration of ninety grains

of thymol, with the usual precautions, 202 samples of the *uncinaria americana* (Stiles) were obtained. It was from samples from this case that material was sent to Dr. Stiles, upon which he has based the recognition of the American species of hookworm, a type placed in the museum at Washington being from the same case; specimens from the same case being used in preparation of the drawings illustrating the present article. At time of examination the patient was a tall, spare, sallow young man, with a blotchy complexion, with a slow, weak type of movement, and with a habit of expression much as described by Stiles (*sup. cit.*) as characteristic of medium infections. There were no evidences of the existence of any important disease, and, because of press of other work in connection with the final school examinations, no blood examination was made. The patient left Galveston the day after the discharge of the parasites; in personal letters he has stated that for some weeks he felt unusually weak, and during the summer he passed through a prolonged febrile course mentioned in his letter as "slow fever." On October 24, 1901, a letter from the patient stated that he had never entirely regained his flesh and strength after this fever, but that his color was slowly returning.

Case V.—McC., white; male; medical student; aged twenty-four years. During the past five years has lived for the most part in Texas, but, as a railroad operator and as a ranche hand, has been in the Indian Territory, Louisiana, New Mexico, Mexico, and Colorado, as well; and in his wanderings has frequently been forced to drink water from very questionable sources. For years he has been in exceptionally good health, except for an eruption of the nature of a giant urticaria, at one time diagnosed by a physician in New Orleans as angioneurotic œdema. For years he has had no malarial paroxysms (but, it should added, shortly after the discovery of the ova of the uncinaria in his stools he had a slight chill, for which, without attempting to find the hæmatozoa, he treated himself with quinine, and has had no recurrence). For two years prior to the discovery of the ova he has suffered from attacks of painful diarrhœa, alternating with periods of obstinate constipation, with occasional small amounts of blood in the stools, which were usually light-colored and soft. No history of "ground-itch;" no dirt-eating habits (save the possibility of conveying dirt to his mouth from his hands when the latter were unclean from work). At time of examination of this case there were no symptoms of importance; very few ova were found at this time (May 8, 1901), along with many trichomonads and a few paramœcia, and at the request of the writer the patient consented to refrain from attempting to get rid of the parasites, in order that some idea might be obtained from the case as to their natural persistence in the intestine. At irregular intervals the stools have been re-examined, the last successful examination having been in the autumn of 1902, the first failure during the Christmas holidays of 1902; at time of preparation of this article (May 3, 1903) a very careful search was again made, but without success, although during the entire interval, and at present, the infusoria noted in the first examination have been encountered. A differential leucocyte count in a specimen of blood obtained at the time of discovery of the ova indicates the following proportions of the white blood cells: eosinophiles, 5 per cent.; small lymphocytes, 23 per cent.; large lymphocytes, 4 per cent.; polynuclear neutrophiles, 68 per cent. No count of red and

white cells was made at the time of the original examination; recently a blood count was made in which a plethora of red cells existed, 5,680,000; white cells, 7600; hæmoglobin (Dare), 90 per cent. There have been no symptoms in the interval referable to the presence of the worms, and their disappearance has seemed to have had no effect on the urticarial eruption above mentioned, and none upon the abdominal symptoms narrated.

Case VI.—On May 9, 1902, in a yellow, clay-like, and mushy stool from a senior pharmacy student, C., a small number of hookworm ova were encountered, together with a few amœbæ and numerous trichomonads. Mr. C., aged twenty-three years, is a resident of Houston County (141), and prior to the above date had never been beyond the limits of the State. Within the past five years he has, in addition to his life at home, lived six months in Huntsville (83), ten months in Runnels County (134), twenty-four months in Galveston, and four months in Lufkin (142), Texas. At his home the source of drinking water was from surface wells; the same in Runnels County; in Lufkin, underground cisterns and surface wells; in Huntsville, overground cisterns and artesian wells; in Galveston, the same. His habits and occupation as a drug clerk give no trace of any dirt method of infection. In general his health has been good for many years; has had no more than two or three chills during the five years prior to examination of stools, and these responded readily to quinine and were regarded as of malarial origin (but without blood examination to verify this belief). Has had no important losses in weight. During the winter preceding examination has noted periods of mental dulness, supposed to have been occasioned by mental fatigue from close study, and suffered slightly from an intermittent diarrhœa. At time of examination Mr. C. was apparently in good health; his complexion clear, with a slight pallor (no more, however, than is common to persons accustomed to an indoor life for years), and with a frequent play of color suggesting a vascular ataxia (the latter a symptom of long standing). No other symptoms of importance could be made out. Leucocyte count from smears taken at this time give the following: eosinophiles, 22 per cent.; small lymphocytes, 16 per cent.; large lymphocytes, 2 per cent.; polynuclear neutrophiles, 60 per cent. On June 11, 1901, after administration of ninety grains of thymol, with the usual precautions, followed by salts, four specimens of the *uncinaria americana* (Stiles) were obtained; and subsequent examination of the stools failed to show the presence of ova. Personal letters from Mr. C. inform the writer that since the above there have been no important features of any type developed in the case.

Case VII.—J., white; male; aged twenty-four years; medical student; residence in Harrison County (95), where he has lived for more than five years prior to the date of examination resulting in the discovery of the parasites in question, for the most part in the town of Marshall, not having been without the bounds of the county in the same length of time, save when in Galveston pursuing his medical studies. The water supply of Marshall is from artesian wells sunk some five miles away from the town; when in the country (Harrison County) the patient's water supply was obtained from springs and from surface wells; in Galveston the water was obtained from the city artesian supply. There was nothing in the history of the case suggesting any dirt habits in the acquirement of the hookworms, and no history

of ground-itch. In the summer of 1900 he had chills (no blood examination) which yielded for the time readily to the use of quinine. During the fall and winter of 1900 and 1901 the chills recurred, and on several occasions the tertian parasite was discovered. These chills continued irregularly up to the time of discovery of the ova in the stools, although during the same period he continued with more or less regularity the use of quinine. During the same period he suffered from an intermittent diarrhœa (stools dark and sometimes almost liquid, without gross appearance of blood admixture), alternating with a few days of constipation from time to time. During this time and up to the date of discovery of the hookworm ova he lost fourteen pounds in weight and became somewhat anæmic in appearance. On May 9, 1901, ova of the hookworm were found in large numbers in the stool in the routine examination of fæces from the various students; and on May 19th, after administration of thymol and salts in the usual manner, there were obtained 389 examples of the *uncinaria americana* (Stiles). Subsequent examinations revealed no further presence of ova in the discharges. Subsequent to the removal of these parasites the patient had one chill, and was at once given quinine in full and persistent dosage, from which time to the present he has been entirely free from further attacks of this type. From this time onward the patient rapidly regained his former health and weight, and his usual ruddy complexion returned. In blood examinations made for the malarial disturbances prior to the examination of the stools it had been noted that there was present a moderate leucocytosis, but not any marked diminution of red cells, and the eosinophile cells were apparently increased (but no differential count of leucocytes was made). Through a misunderstanding, the patient, an advanced student who was to have made for the writer an estimate of the blood cells before taking the anthelmintic, did so after the worms had been discharged, in which examination a distinct and interesting plethora of red cells was recognized (6,100,000), probably due to the withdrawal of a distinct part of the watery element of the blood; at the same time the leucocytes were distinctly increased (20,000 to the cubic millimeter).

CASE VIII.—G., white; medical student; aged nineteen years; a resident of Austin County (244); has never been outside the State limits; has lived for two years in Galveston, as required in his medical work, and for a short time, during vacations, in Lavaca County (207). In both of the latter places the source of drinking water was from artesian wells (in Galveston also from overground cisterns), and at his home from surface wells. There was nothing in the patient's history bearing on the acquirement of the parasites through dirt habits, unless through the eating of raw garden vegetables, which might, possibly, at times not have been sufficiently well washed; the patient recalls that several years prior to the discovery of the ova in the stools he had had a severe "ground-itch" about the hands and wrist, supposed to have been acquired from the garden ground in which he was then employed for a large part of his time. In 1900, while living in Austin County, the patient had for about five months suffered from a severe indigestion, but had had no diarrhœa or pain of importance in connection with the attack. About this time, too, he had had a number of malarial paroxysms, which always were checked by the use of quinine, until after he came in the fall of the same year to Galveston to college. In

the latter city a blood examination revealed the presence of the tertian parasite, and in spite of persistent treatment with large doses of quinine the affection grew worse. At the time of examination (May 21, 1901) the man was slightly anæmic, his complexion blotchy, and he exhibited an unusual degree of tremulousness of the hands and face; there were no appreciable respiratory symptoms; no vascular or circulatory disturbances; he complained of easy physical fatigue and mental tire; slight, dull, uncomfortable feeling, general throughout the abdomen; no important digestive failure; no urinary symptoms. On May 21, 1901, a number of uncinaria ova were found in his stool, and on May 24th ninety grains of thymol were administered, resulting in the recovery from the stools of sixteen examples of the *uncinaria americana*. Subsequent examination of the stools failed to reveal further presence of ova. Differential leucocyte count in smears, taken just before the administration of the thymol, showed the presence of an eosinophilia of 12 per cent.; small lymphocytes, 20 per cent.; large lymphocytes, 6 per cent.; and polynuclear neutrophiles, 62 per cent. After taking the thymol and continuing the use of the quinine as before, there occurred two further chills, after which the entire symptom group referable to malaria completely disappeared; and to the present the patient has been steadily improving, having lost all symptoms save his tremulousness, which is no longer comparable, however, to its former degree.

UNCINARIASIS IN THE UNITED STATES. At the time of the discovery of the parasites in the above-mentioned cases it was not suspected that there existed in man any other species of the hookworm than that first described by Dubini[1] in 1843, under the name *anchylostoma duodenale*,[2] and the few cases published from the United States had been invariably spoken of as if identical with this old-world species—a belief which, in the light of our present knowledge, is a matter of more or less doubt for the individual cases. So, too, although a foreign importation was at least suggested in such cases, it is equally a matter of doubt whether the parasites were not really obtained in the localities where found. Certain writers speak of its recognition (referring to *uncinaria duoden-*

[1] Annal. univers. di med., April, 1843, vol. cvi. pp. 5–13.

[2] In this paper the writer has employed the term *uncinaria duodenalis* (Dubini) Railliet, 1885, as the proper generic and specific name of the old-world hookworm, more commonly spoken of as *anchylostoma duodenale*, Dubini, 1843. The generic title *anchylostoma* was preceded by that of *uncinaria* (Froelich, 1789) for those meromyarial strongyloid worms whose anterior extremity is curved dorsally into a hooklike shape. The division into the proposed genera *uncinaria* and *anchylostoma*, resting mainly on the absence or presence of distinct hooks upon the rim of the buccal capsule, seems scarcely justifiable; the gradation is clear from *uncinaria canina*, with its bilateral ventral trios of such "teeth, to *uncinaria duodenalis*, with its bilateral pairs of similar structures in the same position, to *uncinaria stenocephala*, with its bilateral single large tooth springing from the lower surface of a prominent ventral lip, to *uncinaria americana*, with its bilateral large ventral chitinous untoothed lip, indicating that such a lip in the last-named worm is but a simplified representative of the more complex buccal armature of the previously mentioned examples, possibly the primitive type of such armature. For this reason, until other data justifying the division of the original genus be brought forward, the writer would prefer to retain all the group possessing buccal armature consisting either of prominent lips or hooklike teeth under the generic classification here adopted.

*alis*) in America at an earlier date than the publication of Dubini,[1] but it is doubtful whether any of the earlier American writers, while probably discussing cases of uncinariasis, had any idea of the real nature of the affection. In this category are to be placed the writers named in the above references, Chabert (1830) and Duncan (1840) in Louisiana, Lyell (1849) in Alabama and Georgia, Heusinger and Geddings in South Carolina, and Little and Letherman in Florida. As far as the writer's knowledge extends, the case of Herff (*sup. cit.*), in 1864, in San Antonio, Texas, which was possibly of Mexican origin, was the first recognized in the United States; and in this case the recognition was uncertain, but probably correct for one or other species of the hookworm. (The specimens shown by White[2] before the Boston Society for Medical Improvement as examples of *uncinaria duodenalis* were Brazilian in origin, having been obtained from a patient of Dr. Wucherer, of Bahia, and their specific classification is at this time uncertain.) Blickhahn's case,[3] reported as *uncinaria duodenalis* in 1893, from St. Louis, Mo., was the first positively recognized in this country; it occurred in the person of a brickmaker, seventeen months in the United States from Germany, and was supposed by Blickhahn to have been imported from the latter country. Probably the actual recognition of the endemic existence of the hookworm in this country rests in the discovery of the ova in 1895, as above mentioned, by the writer; but the failure in that instance to discover the host made it undesirable to give any publicity at this time of the fact, and, of course, no strict priority can be claimed because of the failure of publication. Moehlau,[4] in 1897, reported five cases (more recently the subject of some doubt) as examples of *uncinaria duodenalis*; and the infection here was supposed to have been imported or to have followed imported cases. Gray,[5] in 1898, encountered a case determined as *uncinaria duodenalis* and known to have developed in Virginia; and in 1899 Tebault[6] described a case which was probably due to the American species, undoubtedly arising in New Orleans. Cases of Porto Rican origin were reported from New York by Ashford,[7] from Baltimore by Hemmeter,[8] and by Boston,[9] of Philadelphia, as having been recognized in 1900. All of these cases, were probably of the American type of the hookworm. Early in 1901

[1] Dolley. Annual of Univers. Med. Sci., 1891. Blanchard, Traité de Zoologie Méd., vol. i., p. 769.

[2] Boston Medical and Surgical Journal, vol. lxxv. p. 427.

[3] Medical News, vol. lxiii. p. 662.

[4] Buffalo Medical Journal, March, 1897.

[5] Virginia Medical Semimonthly, September 27, 1901.

[6] New Orleans Medical and Surgical Journal, September, 1899.

[7] New York Medical Journal, April 14, 1900.

[8] Stiles. Eighteenth Annual Report Bureau of Animal Industry, U. S. Dept. of Agriculture, p. 210.

[9] Allyn and Behrend. American Medicine, July 13, 1901.

Dyer[1] reported a case of certain domestic origin, probably of the American type of parasite. In the same year a case was recognized in Albany, N. Y., as *uncinaria duodenalis* of Philippine origin, by Ward,[2] and a second, probably of Italian origin, by Neuman.[3] The case reported by Dr. M. C. Schaefer[4] from Galveston, in April, 1901, before the Texas State Medical Association, was undoubtedly of Mexican origin. It was reported under the name *anchylostoma duodenale* (*uncinaria duodenalis*), but the writer has, since the establishment by Stiles of the species *uncinaria americana*, definitely identified it with the latter. It was discovered in February, 1901. In the paper of this author the writer's first two cases were mentioned, both later identified as *uncinaria americana*, both having been found in March of the same year. In May of 1901 the remaining six of the above series described in this paper were encountered, these, also of the American species; and later in the year two more cases of the same type, not yet published, were found in the wards of Galveston hospitals by Dr. J. T. Moore. Shortly after the cases of the writer's series, Claytor met with a case of *uncinaria americana* originating in Virginia,[5] and quickly following appeared the discovery of a case of *uncinaria duodenalis* of Italian origin in Philadelphia, by Allyn and Behrend.[6] Later in the year the case of Hall[7] and Yates[8] was published, having been encountered in the person of a sailor usually travelling between England and the United States, but who had recently been in Vera Cruz, Mexico; this proving to be a case of the old-world hookworm. Still later in 1901 Bailhache[9] described a case from New York, of uncertain species and of uncertain origin (South America?).

Subsequent to these reports of hookworm in this country, publications of similar discoveries in a wide range in the United States have appeared, principally in the Carolinas, Georgia, Florida, Alabama, and Texas, but also from Illinois and California—although the reports from the latter States would indicate the infection to have taken place in Panama, the Philippines, Mexico, and Porto Rico, and at least one case to have been an instance of *uncinaria duodenalis*.[10] Of these pub-

[1] Interstate Medical Journal, March 15, 1901.

[2] Albany Medical Annals, January, 1903.

[3] Stiles. Eighteenth Annual Report Bureau of Animal Industry, U. S. Dept. of Agriculture, p. 215.

[4] Trans. Texas State Medical Association, 1901; note in Texas Medical News, May, 1901; Medical News, October 26, 1901.

[5] Philadelphia Medical Journal, June 29, 1901; THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, January, 1902.

[6] American Medicine, July 13, 1901.

[7] Journal of the American Medical Association, November 30, 1901.

[8] Johns Hopkins Hospital Bulletin, December, 1901.

[9] Stiles. Eighteenth Annual Report Bureau of Animal Industry, U. S. Dept. of Agriculture, p. 215.

[10] Stiles. Bull. No. 10, Hygienic Laboratory, U. S. Public Health and Marine Hospital Service, February, 1903; Herrick, American Medicine, July 19, 1902; Harris, ibid., July 19, and November

lications none approach in importance the bulletin of Stiles, who, as zoölogist of the United States Public Health and Marine Hospital Service, has added much the greater part of our knowledge of the distribution and influences of the American type of hookworm. To Stiles, too, is due entirely the credit of establishment of the species *uncinaria americana* and its exact differentiation from the previously known *uncinaria duodenalis*, using as material specimens from Porto Rico and Ashford's cases, from Claytor's Virginia cases, and from Case IV. of the writer's series from Texas.[1] The same author, basing his opinions upon theoretical grounds, obtained in his studies in comparative parasitology and a few cases reported from this country, had in 1901[2] called attention to the probably wide prevalence of hookworm disease in man in the southern parts of the country, a position amply proved by his own brilliant discoveries and the added testimony of others during the past year.

From personal study of examples of the parasites obtained from the cases detailed above, the writer was aware of a distinct difference between these worms and *uncinaria duodenalis*, and from some similarities to *uncinaria stenocephala* of the dog was at first inclined to believe the parasites of Dr. Schaefer's case and of Cases I. and II. of the above series found in the Texas medical students to be a variety of the latter, and that perhaps dogs bore some part in the disease and its prevalence among men. After the publication of Stiles, announcing the species *uncinaria americana*,[3] no difficulty in establishing the identity with the latter of the parasites in all the Texas cases was experienced. Thus far, in these and other cases coming to his knowledge in this State no examples of *uncinaria duodenalis* have been recognized.[4] So, too, the majority of specimens met in the southern United States generally, in Porto Rico and elsewhere in the West Indian Islands, and at least some of those originating in Mexico and elsewhere in Spanish America are known to belong to the same species; which, hence, must have a wide American tropical and subtropical range of distribution, and which there is reason to believe has been carried thence into other parts, as into the Philippines, and, possibly, into the Spanish peninsula in Europe by travel.[5] In these Spanish and Portuguese-American districts

15, 1902; Smith, ibid., June 21, 1902; Capps, Medical News, November 29, 1902, Journal of American Medical Association, January 3, 1903; and Brown, Occidental Medical Times, March, 1903.

[1] Type specimen No. 3310, Bureau of Animal Industry, U. S. Dept. of Agriculture.

[2] Texas Medical News, July, 1901.

[3] American Medicine, May 10, 1902.

[4] Since writing this paper the author has encountered, in July, 1903, a case of pernicious anæmia dead from the old-world hookworm, which he proposes to use in a further paper as a basis of comparison with *uncinaria americana*.

[5] As a matter of scientific interest it should be inquired into whether possibly the reverse of the above idea may not be true, *i. e.*, whether *uncinaria americana* may not be an East Indian parasite which was perhaps carried into tropical America with the ancient inhabitants, who

there are also to be met instances of the old-world hookworm, probably brought in a similar manner from Europe to this continent. From our present knowledge of the influences of the parasite, it seems certain that many of the early references by American writers to endemic anæmias associated more or less with the dirt-eating habit are to be correlated with uncinariasis, and it, therefore, is not unreasonable to think that, probably, the worm was endemic among the aborigines of the above-mentioned areas of America, and was transmitted by them to the whites, and thus to the present occupants, generation by generation.

Description of Uncinaria Americana (Stiles). Superficially, *uncinaria americana* (Stiles) bears close resemblance to *uncinaria duodenalis*, differing mainly in the nature of the buccal armature; it is somewhat smaller, as a rule, but individual instances attain the lower measurements named for the old-world parasite; there are also slight but important differences in the sexual bursa and its rays in the male worms, and the ova of *uncinaria americana* are larger than those of *uncinaria duodenalis*, and are apt to be found in more advanced embryogenesis

Fig. 2.

Showing actual size of male and female uncinariæ.

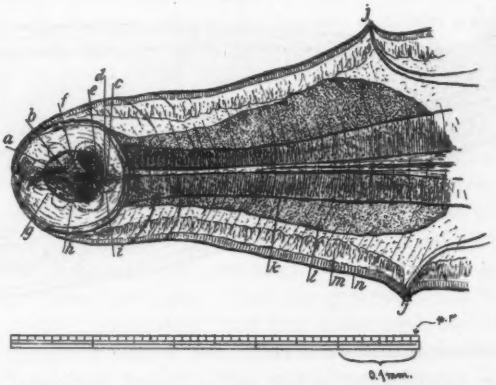
These worms are nematodes of the family *strongylidæ*, subfamily *strongylinæ*, genus *uncinaria*. They are elongate, cylindric, tapering in both sexes toward a blunt head end, and having the anterior extremity curved dorsally, this giving the characteristic "hook" type of the genus *uncinaria*. The posterior extremity of the female is mucronate; the male ending suddenly in a blunt tip, without gradual contraction, within the caudal bursa. The color is whitsh or cream-colored, sometimes the contents of the alimentary canal giving the worm a slightly brownish tint in the middle half. In their thickest part they average 0.4 mm. in thickness, ranging from 0.3 to 0.6 mm.; the males are usually 7 to 8 mm. in length, ranging from 6 to 9 mm.; the females usually 10 to 11 mm. in length, ranging from 8 to as much as 14, or even 15 mm. occasionally (Fig. 2). The measurements given by Railliet[1] for the male *uncinaria duodenalis* are 8 to 11 mm. in length, females, 10 to 18 mm.

are more or less generally regarded as the progenitors of the South and Central American and Mexican races of American aborigines. Could a marked predominance of this species be established as existing in Eastern Asia and the Pacific archipelagos, particularly in the relatively uncivilized Pacific islands, it would not only be of importance from a point of medical geography but also would prove a valuable item in ethnography.

[1] Traité de Zool. Méd. et Agric., Paris, 1895, p. 465.

The mouth opening is directed dorsally, and is to be seen only in specimens arranged to exhibit the dorsal side of the head (Fig. 3). It is formed by the delicate, transparent cuticle, which here becomes continuous with the lining of the buccal cavity. It is of an elliptical shape, its long axis directed anteroposteriorly, measuring 50$\mu$ to 70$\mu$ in long axis, and 40$\mu$ to 50$\mu$ transversely (but varying considerably in different specimens, and, undoubtedly, in life capable of considerable contraction and expansion). The walls of the buccal cavity are supported throughout the greater portion by a chitinous capsule of a cup shape. This is composed of at least four pieces, two large curved lateral plates incompletely separated along the dorsomedian and ventromedian lines, a thin, curved quadrilateral plate placed internal to

FIG. 3.



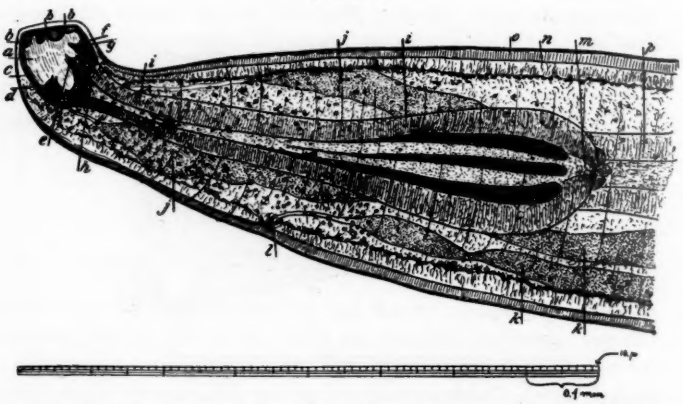
Dorsal view of cephalic end of *uncinaria americana*. *a*. Oral cuticular margin. *b*. Large chitinous ventral lip. *c*. Smaller chitinous dorsal lip. *d*. Dorsal conical tooth. *e*. Lateral lancets. *f*. Ventral lancets. *g*, *h*, *i*. Oral papillæ. *j*. Cervical papillæ, with ductus of cervical glands. *k*. Muscular wall of œsophagus. *l*. Œsophageal glands. *m*. Muscular layer of body wall. *n*. Cuticle.

the dorsal line of separation of the lateral plates (dorsal extension of dorsal conical tooth), and a thickened marginal ring serving as a rim to the cup, also incompletely divided dorsally and ventrally. The latter bears on each side of the capsule two lips, the larger ventral lip (the analogue of the ventral hooklets of *uncinaria duodenalis*) projecting into the buccal space beyond the margin of the true mouth, the smaller dorsal lip extending close or quite to the margin of the latter. Beneath (toward the base of the capsule) these lips on each side of the capsule may be seen three papillæ projecting into the cavity, the ventral and lateral directly beneath the large ventral chitinous lip, the smaller beneath the smaller dorsal lip about its middle. These papillæ are covered by the oral membrane which rises in longitudinal folds

from below upward to the apices of the papillæ, giving rise to faint lines from the pharyngeal armature toward the rim of the buccal capsule. In some specimens the papillæ appear spiculated at the tip.

The shape of the buccal capsule may be apprehended from the accompanying drawings of the dorsal and lateral views of the head (Figs. 3 and 4). Viewed from the dorsum it is seen to have at the rim an almost circular outline, and deeper in the cavity to be slightly elliptical, the transverse diameter being slightly larger than the dorsoventral. Viewed laterally the rim of the capsule is nearly straight, in general parallel with the long axis of the worm, while the ventral line is the longest and most curved boundary, the line of the base being nearly

FIG. 4.



Lateral view of cephalic end of *uncinaria americana*. *a*. Buccal cavity. *b*. Oral papillæ. *c*. Chitinous capsule. *d*. Ventral lancets. *e*. Lateral lancets. *f*. Dorsal conical tooth, with (*g*) its posterior extension reinforcing part of capsule. *h*. Interior of œsophagus; its chitinous wall continuous with the pharyngeal teeth above. *i*. Muscular wall of œsophagus. *j*. Œsophageal glands opening into the pharynx. *k*. Cervical glands opening externally at cervical papillæ, *l*. *m*. Trilobed valvular opening of œsophagus into intestine. *p*. Intestine. *n*. Muscular layer of body wall. *o*. Cuticle.

straight and directed in nearly a right angle to the line of the rim. A short, straight dorsal limit connects the rim with the dorsal end of the base line. There is some variation in the measurements in different specimens; but, as a rule, the distance from the extreme depth of the buccal capsule to its rim is 100$\mu$; the dorsoventral diameter (outer lines) at the widest part is about the same, the transverse diameter being equal to the latter at the upper part and slightly greater in the broadest portion, deeper within the cavity.

Through the base of the capsule rises the chitinous lining of the pharyngeal portion of the œsophagus with the peculiar pharyngeal armature of the worm. This consists of certain chitinous tooth-like

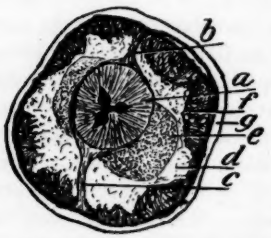
structures joined more or less in continuity by reflections of the lining membrane of the cavity, so as to form a funnel-like opening supported by the chitinous projections. There are five principal chitinous elements, with several small intermediate ones, set into the chitinous wall of the pharynx. Of these the most striking and unvarying in position is the so-called "dorsal conical tooth," set in the dorsal wall and reinforcing by its dorsal plates the break in the dorsal wall of the buccal capsule (Figs. 3 and 4). It is composed of a chitinous plate rising well into the buccal capsule cavity, arched from side to side so that the dorsal surface is slightly convex, while at the median line a groove in the dorsal side causes a slight longitudinal fulness on the ventral surface, in some positions giving the impression that the tooth is longitudinally divided. The plate rises to a pointed tip, and, as it does so its sides fold dorsally and again rise back of the tooth as a reinforcement of the posterior wall of the capsule, and bear a fold of the oral membrane, which thus dorsally envelops the tooth. The other four chitinous elements are symmetrically arranged, two on either side of the median line. The laterals are to be seen on either side and close to the dorsal conical tooth, each rising as a thin conical projection with spiculated tip (thus in lateral views—from above downward or dorsoventrally, more widely conical), evidently moving transversely and slightly dorsoventrally in projection and retraction of the œsophagus. These receive the fold of membrane from the dorsal plates of the dorsal conical tooth, and are connected by similar and deeply curving folds with the ventral teeth. They are apparently also connected with each other by a similar fold extending transversely and on the ventral side of the dorsal conical tooth, this fold forming the dorsal boundary of the pharyngeal funnel. The ventral teeth, known as the ventral lancets, are broadly conical when viewed laterally, narrower when seen from above downward or ventrodorsally. When everted they lie close to the curved ventral boundary of the buccal capsule, one on either side of the median line, a deep groove separating them, save where a loose low fold of the oral membrane extends between them to form the ventral border of the pharyngeal funnel. Laterally, a fold passes from each to join the neighboring lateral tooth, forming the low lateral margin for the funnel of the pharynx. These ventral lancets are moved in action toward the dorsal conical tooth and from above downward, with possibly a slight lateral play. They are spiculated at the tip.

In effect this arrangement is admirably adapted to the suctorial habits of the worm. When the œsophagus is forced forward into the base of the capsule the pharyngeal membrane and its attached chitinous teeth are everted to form a rather wide funnel, into which is drawn a tiny part of the intestinal mucous membrane of the infected individual

when the worm is feeding; the œsophagus is then retracted, bringing the tips of the ventral lancets dorsally and downward and the tips of the lateral teeth toward the median line on the ventral side of the dorsal conical tooth (Fig. 3). The latter in this movement is drawn slightly ventrally, but is apparently less motile than the other elements. Close about the bit of tissue thus grasped the membranous pharyngeal border is drawn, insuring efficiency of suction from the tiny wounds inflicted by the action of the chitinous teeth. Doubtless in grasping the mucous membrane of the host the whole capsule with its chitinous lips and papillæ plays an important part, movements of retraction of the œsophagus at the base of the buccal capsule tending to spread the transverse diameter of the buccal rim, and protrusion of the œsophagus into the base widening the latter and narrowing the rim; the alternate capsular and pharyngeal action suggesting a high degree of service in the work required.

From the above description it may be readily apprehended that much confusion is to be expected in the study of this apparatus, either in sections or in the undivided head; the relative position of the teeth and pharyngeal membrane varying so as to present quite different appearances of detail in different specimens, even in practically the same plane of section or in the same direction of examination. Probably the easiest mode of study is obtained by dividing the neck as close as possible to the head, so as to relax the œsophageal structures, when the pharyngeal funnel and its chitinous elements are likely to assume a fairly separated and distinct position for observation. By careful manipulation such a head may be studied in water, with and without a cover, in its different aspects without much difficulty.

FIG. 5.



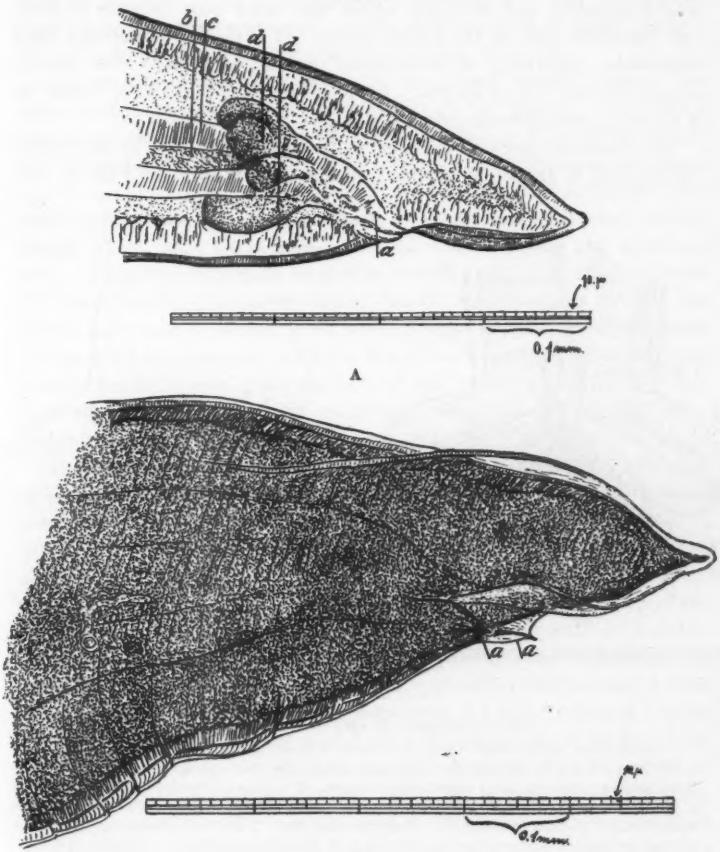

Transverse section of upper œsophageal valvular expansion, showing triradiate appearance of interior. *a*. Œsophagus. *b*, *c*. Dorsal and ventral muscular attachment of œsophagus. *d*. Body space. *e*. Œsophageal glands. *f*. Muscular wall. *g*. Cuticle.

Two glands, the œsophageal glands (Fig. 4), open into the base of the capsule, apparently just within the line of the ventral lancets. These may be presumed to furnish a salivary fluid destined to aid in preserving the fluidity of the blood as it is being drawn from the wounds inflicted by the chitinous teeth, and may possibly have some toxic influence upon the individual infected, and thus be an element in the production of the clinical features of uncinariasis.

Viewing the head from the dorsal aspect the œsophageal opening is seen beneath (ventrad) the dorsal conical tooth as a crescentic opening (convexity directed ventrally), into which the lateral teeth extend from

the sides toward the median line; and from the ventral border the ventral lancets extend dorsally across it. It should be remembered, however, that a groove corresponding to the space between the ventral

FIG. 6.




Posterior extremity of female *uncinaria americana*.

A. Lateral view: *a*. Anal papillæ. *b*. Interior of intestine. *c*. Wall of intestine. *d*. Anal glands.

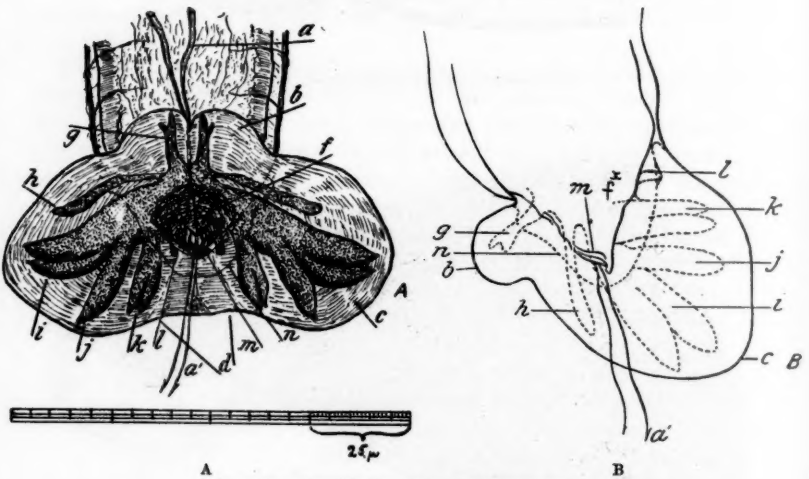
B. Same subject from a somewhat larger specimen and viewed ventrolaterally, showing anal opening expanded: *a*. Anal papillæ, showing small chitinous tips.

lancets, but hidden by the pharyngeal membrane between these structures, exists, and that, therefore, the opening is really triradiate, an appearance carried into the upper part of the œsophagus (Figs. 4 and 5).

The œsophagus (Fig. 4) is a thick-walled muscular structure, in its upper portion lined internally by chitinous material. It is of an elongate flask-shape, circular in transverse section, its upper end terminating abruptly at the base of the buccal capsule, to which its outer portion is attached and through which the inner part slightly projects into the lower part of the buccal cavity. It is thicker posteriorly than anteriorly, measuring at its thickest part about 150$\mu$ to 160$\mu$, and is about 700$\mu$ to 750$\mu$ in length. At its posterior extremity it opens by a valvular arrangement into the straight, wide intestine.[1]

The intestine opens in the female by an anus guarded by small anal valves close to the tip of the tail on the ventral surface (Fig. 6). In

FIG. 7.




A B

Posterior extremity of male *uncinaria americana*.

A. Dorsal view, bursa spread open and dorsal lobe thrown upward over body of worm: *a*. Inner end of genital spicules. *a'*. External barbed extremity of spicules. *b*. Subdivided dorsal lobe of bursa. *c*. Large lateral lobe of bursa. *d*. Limits of inconspicuous ventral lobe of bursa. *f*. Dorsal aspect of tip of tail within bursa. *g*. Bipartite-tipped dorsal ray. *h*. Dorso-lateral ray. *i*. Divided lateral ray. *j*. Ventro-lateral ray. *k*. Divided ventral ray. *l*. Inconspicuous subventral ray. *m*. Opening of cloaca, with chitinous furcula. *n*. Cuticle of tail.

B. Lateral outline view of same; letters as above.

the male it terminates in common with the sexual organs in the blunt tip of the tail lying within the caudal bursa, the opening being on the dorsal side close to the tip (Fig. 7). Externally the worm is covered by a delicate, transparent, and finely transversely striated cuticle

[1] In a subsequent paper the writer wishes to describe more fully and exactly the details of the oral parts and the general structure of the worm, and for this reason prefers in the present discussion to pass briefly the features which are non-distinctive of this special parasite.

showing lateral, dorsal, and ventral longitudinal lines, the first being the more distinct. Beneath the cuticle is a layer of muscle, meromyarial, with internal extensions for the support of the intestine, sexual organs, and other structures. On the external surface, about 300 $\mu$ back of the base of the buccal capsule on each side of the worm, there is to be seen a rather prominent papilla, at the summit of which opens a duct of a large gland, the cervical gland (Figs. 3 and 4).

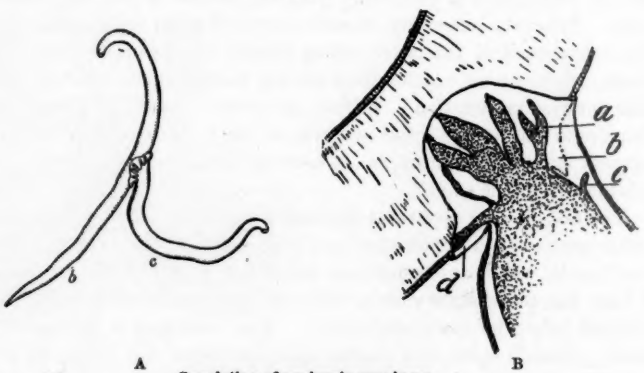
The sexual apparatus, particularly the sexual caudal bursa of the male, is of importance in the identification of the species. The female genital opening is apparent on the ventral surface at a point just within the anterior half of the specimen, guarded by two transverse lips forming the sexual valve. From this a short vaginal canal extends internally and divides into the anteriorly and posteriorly directed uterine canals, which lie in a tortuously plicated manner along the intestinal tube. From the extremity of each a narrow tubal continuation forms the ovary, each of the latter ending blindly in the upper part of the worm, the posterior ovarian tube having turned upon itself to attain this anterior termination. Within the uterine canals of the pregnant females are to be seen great numbers of ova in various stages of development and segmentation, in occasional instances the embryo being visible within the shell.[1]

The male sexual apparatus consists of a pair of testicles, long narrow tubes analogous in appearance and disposition to the ovarian tubes of the female, which unite suddenly about the middle of the specimen in a large sac, the seminal vesicle, which in turn opens into a rather large, straight tube (the ejaculatory duct). This continues to the tail of the worm, where it opens in a papilla upon the dorsal side of the tip of the tail (Fig. 7). From this opening, whose sides are supported by a chitinous furcula the cornua of which are connected by a transverse lip, emerge two delicate filaments apparently of cuticular structure, retractile, barbed at the free end, and measuring 0.9 mm. in length (sexual spicules). Surrounding the caudal tip is the sexual bursa, an umbrella-like expansion formed of the folded cuticle, between the folds of which the muscular layer of the body wall sends out a number of finger-like extensions or rays which serve to expand the bursa or bring its lobes in apposition. In the expanded state (Fig. 7, A) this bursa presents a distinctly trilobed outline made up of two large lateral lobes and a partly divided smaller dorsal lobe; while the ventral outline shows a slight curvature forming an indistinctly marked ventral lobe. From about the tip of the tail in the middle of this bursa the rays emerge

[1] Stiles working over material from Case IV. of the above series observed an instance of this almost viviparous possibility; in material from two other cases the writer has encountered similar appearances. The stools in each of these instances were quite fresh, and numbers of the worms exhibited active movements when obtained, and were at once placed in a formaldehyde solution for preservation.

symmetrically from the body wall; a common base dorsally gives origin on each side of the median line to a small dorsal ray with bipartite tip and a long, slender, slightly clubbed dorsolateral ray (the latter bending into the dorsal portion of the lateral lobe of the bursa; laterally from a common base on each side spring a large, thick, divided lateral ray, a smaller simple ventrolateral ray and a divided ventral ray; near the ventromedian line on each side one may distinguish also a short, single, inconspicuous subventral ray. The ends of these rays are provided with tiny chitin-like tips. Transversely the bursa measures 95$\mu$ to 100$\mu$, the dorsoventral measurement being from two-thirds to three-fourths as great according to the degree of expansion obtained in the specimen observed.

FIG. 8.




A B

Copulation of *uncinaria americana*.

A. Moderately large view of (*b*) male and (*c*) female in coitu.

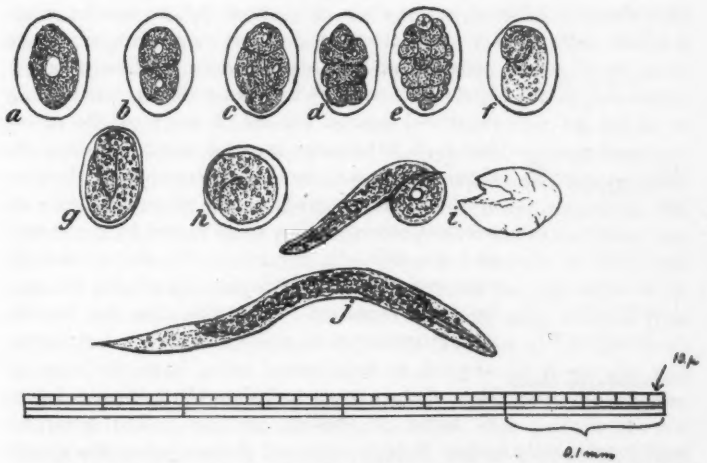
B. Detail of bursal application of male to body of female, higher enlargement: *a*. Ventral ray of male. *b*. Anterior lip of vagina. *c*. Subventral ray of male. *d*. Dorsal ray of male.

In coitus the male applies this bursa with its muscular rays about the ventral and lateral aspects of the female, so as to bring the sexual papilla in close apposition and slightly penetrating the female opening, the sexual spicules extending into the vaginal and uterine canals. The coitus is prolonged; and occasionally specimens are expelled in congress after administration of the anthelmintic to the host, the bodies of the male and female, together, forming a Y-shaped combination as shown in the accompanying drawing made from a pair thus obtained from T., Case IV. of the above series (Fig. 8).

The ova, formed within the uterine canals of the female worm, are passed through the genital pore in large numbers, and constitute an easily recognizable microscopic element of the feces of the host. No special technique is required for their discovery beyond the application

of a small bit of the suspected stool upon a glass slide with a drop of water, if needed, to make the specimen nearly fluid, the adjustment of a cover-slip, and the use of a magnifying power of from 100 to 400 or 500 diameters, as may suit the wishes of the observer. In cases of even but moderate degree one rarely fails to find in the first bit of feces thus examined several of the ova; and in mild cases anyone familiar with the appearances should, with the low power of the microscope, be able to find within ten or fifteen minutes at least, one or more of the eggs in four or five trials. The ova have an elliptical outline (Fig. 9), are colorless, with a thin, transparent covering, and a granular interior in varying degrees of segmentation, or with a small

FIG. 9.



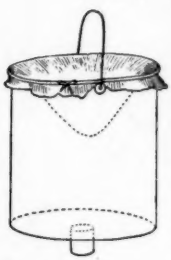

Ova and embryos of *uncinaria americana*. *a*, Unicellular ovum. *b*, *c*, *d*, *e*. Ova showing various stages of segmentation. *f*, *g*. Ova containing larval uncinariæ. *h*. Peculiarly shaped ovum. *i*. Larval worm just emerged from shell. *j*. Larva extended after emergence.

rhabditiform embryo enclosed. They measure in long axis 68$\mu$, transverse 38$\mu$ to 40$\mu$, with slight variations above or below these measurements in different specimens, the measurements of the ova of the *uncinaria duodenalis* given by Railliet being 52$\mu$ x 32$\mu$.

In the recovery of the parasites from an individual in whose intestinal discharges the ova have been found, little difficulty has been experienced by the writer from the use of thymol. Filix mas has been lauded by a number of writers for the dislodgement of the *uncinaria duodenalis;* and in the first case of *uncinaria americana* falling under the writer's observation (the case of S., recorded by Dr. M. C. Schaefer, *sup. cit.*) this was in the beginning employed, but without success. A later use of

thymol in the same case was successful in removing one hundred and two specimens of the parasite; but in spite of several repetitions, occasional ova were detected in the stools thereafter. In the series of cases mentioned in the present article thymol was administered in six cases, in all being followed by the discharge of a greater or smaller number of the worms; and in none of these cases were ova discoverable in the stools subsequent to the single administration of the drug. In practice the writer has followed the method of administration commonly employed on the Eastern continent for the old-world hookworm. The patient, either with or without previous light purgation, is given a liquid supper the day before administration of the drug, and in the morning following is denied food until the bowels begin to act freely. At about seven o'clock in the morning, thirty grains of thymol in several capsules are administered, followed at intervals of an hour by two similar doses. An hour later (about ten o'clock) a dose of magnesium sulphate is given if the loose stools have not already started. Until free action is had the patient is particularly cautioned against the use of any alcoholic or oil, lest such substances ingested should dissolve the thymol freely and lead to toxic symptoms. In none of the cases observed by the writer was such an accident observed. The stools caused by the thymol and the saline (in several of the above cases the salts were not used, the thymol alone being followed by free evacuation before the time set for the administration of the saline) are thin, watery, generally of a dark-brown color, have the odor of thymol upon them, and show the undissolved drug in larger or smaller particles. The stools are most conveniently washed through a piece of cheese-cloth under a moderately forcible thin jet of water from the tap. A filtration bucket (Fig. 10), with the cheese-cloth fastened about the rim, so as to form a shallow funnel within, has answered the purpose well. When there is much mucus in the stool, preventing free filtration, the previous addition of an alkaline hydrate solution so as to dissolve the mucus has much hastened the operation. The washing is most rapidly done by putting but small portions of feces in the funnel at one time; and the jet of water should be played about the margins of the fecal matter to most rapidly carry the material through the cloth. The solid remnants after washing are transferred to a shallow dish filled with water, in which the parasites sink to the bottom, when they may be readily distinguished and removed to a separate container.

FIG. 10.



Filtration bucket used in washing fecal matter.

LIFE-HISTORY. The life-history of the particular species of hookworm under consideration has not been determined, but there seems

no reason to believe it materially different from that of the allied old-world species. The latter is known after emergence from the egg as a rhabditiform embryo, to undergo in its free state at least two moults, experimental observations after alimentary infection of dogs indicating that it subsequently undergoes a third and fourth ecdysis within the host; after which it is fully formed, but requires further growth to attain its adult size. From four to six and from some experiments as much as ten weeks seem requisite for its full development from the time of infection. The ova of *uncinaria americana* under suitable conditions (involving a fair access of oxygen, moisture, and a temperature of about 30° C.) give origin within twenty-four hours similarly to a rhabditiform embryo, measuring 220$\mu$ to 250$\mu$ (Fig. 9). Stiles (*sup. cit.*) has recognized these after the first and second moult in the free state, after two to three days for the first, and after seven to nine days for the second; and the same author insists upon the need for free access of air to the ova for rapid incubation, indicating that a moist, loose, sandy soil affords the most favorable situation in nature, and that hatching is prevented by actual submersion in water. The writer has made no attempts to follow the development of the parasites, but has found the embryos in numbers in thin fecal material exposed to the air for less than twenty-four hours at ordinary room temperature, suggesting that other conditions than mere submersion may have led to the latter conclusion of Stiles. In an attempt to grow the larvæ in a solid fecal mass at body temperature in a small incubator the eggs failed to incubate, and did not develop in the same substance after removal from the incubator to the general atmosphere of the room within five or six days. At the time it was not thought that the faulty factor was lack of moisture, the failure being attributed at the time to the temperature; but it seems not unreasonable to think that perhaps the real trouble was occasioned by drying (the stool was not, however, at any time dry beyond a putty-like consistence).

After emergence from the egg the embryo lives well in water; and either in unclean drinking water or in infested moist dirt adherent to various articles carried to the mouth, is probably, in a large number of instances, transferred from its free life to the alimentary canal of the host. The habit of "dirt-eating" or "clay-eating" has long been regarded as a probable mode of convection of the larvæ of *uncinaria duodenalis* from their free life in dirty water or in mud to the human host, an idea Stiles has correlated with the American hookworm and the "dirt-eater's anæmia" or "mountain anæmia" frequently met in the "poor white" class of our Southern States. In a large proportion of these dirt-eaters, doubtless, uncinariasis does exist, and, probably, sometimes the habit has occasioned the parasitism by the fact that the dirt eaten by the individual has contained embryo uncinariæ. It should not be lost to mind,

however, that dirt-eating is not necessarily mud-eating, and that much of the unclean matter chewed or actually eaten by these people cannot possibly have uncinariæ in it. Frequently the habit is limited to the eating of some particular kind of dirt, as soot taken directly from the chimney, ashes from the hearth, ashes from a tobacco pipe, mortar taken from between bricks in a wall, dry ground, straw or chips; and the true "clay-eater" must be less likely than the real soil-eater or mud-eater to get the worms in his dry or semi-dry clay. Doubtless the habit is often secondary to the anæmia occasioned by the parasite, just as the pica of chlorosis is a symptom rather than causative of the condition. Aside from the actual habit just discussed, it should be kept in mind that mud, possibly carrying the embryo parasites, may be carried to the mouth by the hands in case of individuals engaged in those occupations occasioning frequent soiling of the hands by such material (brickmakers, gardeners, ditchers, and others), or by improperly washed vegetables grown in moist ground (as celery, radishes, cress, etc.). Careful inquiry of the individuals of the above series has failed to indicate any habit of the kind, a habit rather unlikely in persons of their station (but by no means excluded by social status); but all were more or less open to infection by drinking surface water, either from ponds, streams, or surface wells, into which, by drainage, there must, especially in a loose soil, be frequent opportunity for the entrance of ova or embryos. The writer cannot set aside suspicion in connection with cistern water, into which there must often be the chance of entrance of ova, which have been deposited by wind and dust upon the roofs of houses, subsequent rains washing them into the cisterns. Stiles' conclusion as to difficulty of incubation when the ova are submerged is opposed to such an idea; yet the writer would point out that in the bottoms of most cisterns in our Southern sand districts there is to be found an ideal mixture of sand, mud, and charcoal (the last added with a view of purifying the water) in which, aside from the submersion, the ova might well develop.

Recently the view (held as early as 1898 by Loos after a personal experience) of entrance of the embryos through the skin of the host with a probably active penetration to their natural habitat in the intestine has been advanced and fully proved by experimentation upon dogs and human subjects by Loos in connection with the old-world hookworm.[1] Independently, Bentley,[2] having found in the fluid of a vesicle of ground-itch an embryo strongyloid which he identified as *uncinaria duodenalis*, arrived at the idea that "ground-itch" or "water-itch" is the product of invasion of hookworm larvæ into the skin, bear-

[1] Centralbl. f. Bakteriol. u. Parasitenk., September, October, 1898; ibid., May, 1901; ibid., February, 1903; Sandwith, Journ. Trop. Med., December 15, 1902.

[2] British Medical Journal, January 25, 1902.

ing with them various bacterial infections, the latter determining the type and severity of the dermal attack; in the study of which he produced experimentally conditions of the same character by application of moist soil containing uncinaria embryos to the skin of human beings. Various persons have correlated these ideas, and the view that the ground-itch described by Bentley (foot-itch of coolies, water-itch, panighao, etc.) is a precedent of uncinariasis has met with considerable favor. Whether the eruptive inflammation discussed under the name of ground-itch is of uniform origin and nature is, however, questionable, its reference to other infections than uncinariasis being common. It may be accepted, however, that hookworm larvæ do find access to the human host through the skin, and in their entrance undoubtedly cause more or less irritation, which may, perhaps, lead to an active vesicular and pustular dermatitis as seen in ground-itch, probably varying in aspect and severity from factors other than the parasitic embryos, and not necessarily representing more than one group of the cases known under the name of ground-itch. No experiments, as far as the writer's knowledge extends, have been undertaken in this relation with the larvæ of the American hookworm; but there are reasons for belief that as much may be said in relation to it and the well-known "ground-itch" or "water-itch" of our Southern States, as has been stated in the above-outlined conclusion. The ground-itch of the southern United States is extremely common among those who are accustomed to go barefoot, especially in moist, sandy places; it is especially common among children, usually affecting the feet and ankles, but also seen about the hands and wrists, and is by no means always associated or followed by symptoms referable to uncinariasis. It is, unfortunately, much confused with a number of somewhat similar affections, as the lesions caused about the toes by the penetration of the "chigoe" or "chigger flea" (*pulex penetrans*) and other minute arthropoda. Inquiry of the subjects included in the series of this paper has failed to elicit any history of any such dermal inflammation within the period of the patient's recollection, save in the last case (G.), who, after working for a period with much constancy in his parents' garden, had a severe attack of the affection about the hands and wrists—and this at a time compatible with the supposed time of infection with the hookworm larvæ.

NOTE. The writer, in view of the length of the present article, would leave further consideration of the subject, particularly including the symptomatology of uncinariasis in its American form and the structural changes following the presence of these worms, to a future contribution. This he is especially desirous of doing, although a section of the present paper as submitted for publication was devoted to semeiology, because

shortly before reading the proof he met a fatal instance of parasitism by the old-world type of hookworm, which promises to prove interesting in comparison with the disease as found in ordinary American cases of uncinariasis, and which he hopes to be able shortly to present to those interested in the subject.

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## THE OCCURRENCE OF UNCINARIASIS (ANKYLOSTOMIASIS) IN SOLDIERS OF THE UNITED STATES ARMY.[1]

By Charles F. Craig, M.D.,
FIRST LIEUTENANT AND ASSISTANT SURGEON, UNITED STATES ARMY; PATHOLOGIST AND BACTERIOLOGIST TO THE UNITED STATES ARMY GENERAL HOSPITAL, PRESIDIO OF SAN FRANCISCO, CAL.

The great interest which has attached to the discovery by Stiles that uncinariasis (ankylostomiasis) is a very common disease in the southern portion of the United States, that it is due to a new genus called by him *uncinaria americana*, and the fact that the disease occurs frequently in the Philippine Islands and is being imported into this country in the persons of soldiers of the United States Army returning upon almost every transport, has led me to believe that the cases which have been observed at the Army General Hospital at San Francisco, Cal., during the past eighteen months should be reported somewhat *in extenso*. Since January 1, 1902, there have been twelve cases of infection with *uncinaria* at this hospital. This number includes only those in which the ova were demonstrated in the stools. Several cases besides these have come here with a diagnosis of uncinariasis, but I have been unable to confirm the diagnosis. This small number of cases must not be considered as being an index of the prevalence of the disease in the Philippines. From conversation with several medical officers who have made examinations of the feces in those islands, I am convinced that the disease is very prevalent and forms a considerable portion of the causes of admission to hospitals. Many of the cases occurring in the Philippines are returned to duty, having recovered from the infection, and only the most persistent cases are received here.

Historical. To First Lieutenant Bailey K. Ashford, Assistant Surgeon, United States Army, belongs the credit of having first called the attention of American physicians to the occurrence of this disease in Porto Rico, where he found it very prevalent. Since his publications numerous investigators in this country have reported cases, but it remained for Stiles to prove, by a series of careful and brilliant re-

[1] Published with permission of the Surgeon-General U. S. A., from the annual report of the bacteriological laboratory of the United States Army General Hospital, Presidio of San Francisco, Cal.

searches, that this disease is very common in the Southern States, especially among the so-called "dirt-eaters." Stiles believes that the latter symptom, *i. e.*, dirt-eating, is due to the perverted appetite caused by the irritation of the *uncinaria* to the mucous membrane of the intestine.

As regards the occurrence of the disease in soldiers of the United States Army, cases have been reported by Ashford, Strong, Curry, and Brown.

In the following report I shall first give the clinical histories of the cases which have been observed here, followed by a description of the parasite and a few remarks upon etiology, diagnosis, and treatment.

CLINICAL HISTORY. Of the twelve cases observed, eight recovered and were discharged from the hospital, three are still in the hospital, and one died. For the following clinical histories I am indebted to First Lieutenants and Assistant Surgeons Edger and Grubbs, and Contract Surgeons Porter, Shepard, and Ashburn.

CASE I.—A. H. W., aged twenty-seven years; birthplace, England; admitted to this hospital January 21, 1902; diagnosis: ankylostomiasis. Patient had been sick in hospital since October 11, 1901. No record is given of symptoms from which he suffered while in Manila. The only physical signs of importance were his distended abdomen, a yellowish-white skin, and anæmic mucous membranes. The tongue appeared clean. The chief thing complained of by the patient was the accumulation of gas in the stomach and bowels, with eructations and more or less colicky pain. His appetite was good, bowels regular, although somewhat inclined to constipation.

The feces were examined on January 24th, and a few *uncinaria* ova were found. On February 3d they were again examined, and no ova were demonstrated. Patient was discharged from the hospital to duty on March 4, 1902, no ova having been found in the feces since January 24th. At the time of his discharge he had gained ten pounds in weight; the mucous membranes were more normal in appearance, and the patient stated that he felt perfectly well.

CASE II.—J. P. S., aged twenty-nine years; birthplace, Chicago; entered this hospital February 17, 1902. Patient was admitted from the United States Army Transport "Meade," and stated that he had been sick since November, 1900; had suffered from constipation, accompanied by vertigo, dyspnœa on exertion, and a sense of pressure over the chest. He had also suffered from occasional pains under the left scapula and along the left side. On admission the patient appeared very pale and anæmic, the skin having a lemon-yellow hue. On examination of the heart a systolic murmur was detected, which, taking into account the anæmia present, was evidently of hæmic origin. The abdomen was somewhat distended, and the patient complained considerably of flatulence. The chief symptoms complained of by the patient on admission were general weakness, vertigo, dyspnœa on exertion, and palpitation of the heart. The feces were examined on May 15th, and a few *uncinaria* ova were found. They had been previously examined on February 26th, and were found negative. Patient was returned

to duty on May 21st, the ova having disappeared. During his stay in the hospital the patient gained sixteen pounds.

CASE III.—W. C. S., aged twenty-four years; birthplace, Maine; entered this hospital October 13, 1902; diagnosis: chronic gastro-enteritis. Patient had been sick since December, 1901, suffering from acute diarrhœa, having six to eight bowel movements in twenty-four hours with some blood. Also had abdominal pain of a colicky nature, and much gastric distention. Upon admission the patient complained of epigastric tenderness and flatulence. He had some diarrhœa, but never passed any blood. He was weak and emaciated; the skin anæmic, as well as the mucous membranes, the abdomen distended, and the ankles somewhat œdematous. The feces were examined on October 14th, and were negative. Examined again on October 29th, when a few *uncinaria* ova were found. This patient remained in the hospital until November 13th, when he deserted, and no further record could be obtained in the case, but before desertion the ova had disappeared from the feces.

CASE IV.—M. S. H., aged thirty years; birthplace, Iowa; entered this hospital October 13, 1902; diagnosis: chronic dysentery and ankylostomiasis. The clinical record in this case is very brief, it being impossible to obtain any data from it as to the symptoms from which patient suffered. The only physical sign noted is a distended abdomen. Feces were examined on October 23d, when numerous *uncinaria* ova were found. On November 15th a few were present, but frequent examinations after this period were negative. The patient was returned to duty on December 10, 1902, his illness having begun in June, 1902. During his stay in the hospital the patient gained ten pounds in weight.

CASE V.—A. L., aged twenty-two years; birthplace, Kentucky; entered this hospital October 13, 1902; diagnosis: æstivo-autumnal malarial fever, chronic amœbic dysentery, ankylostomiasis. Patient's illness began in August, 1902. He had a severe diarrhœa, passing blood-stained mucus. Suffered severely from colicky pains in the abdomen and from abdominal distention. On admission he was much emaciated and very weak. Was having numerous bowel movements, the stools being thin and watery, with but little mucus and no blood. Patient complained mostly of abdominal distention and colicky pain. Physical signs were those of anæmia, the skin being yellowish in color, the mucous membranes pale, and upon auscultation a slight hæmic murmur was heard over the larger vessels, especially in the neck. The feces were examined on October 14th, and a few *uncinaria* ova were found, together with a few embryonic worms. On October 16th the patient had a chill, accompanied by the symptoms of malaria, and examination of the blood showed a few full-grown tertian parasites. This condition was quickly remedied with quinine. The patient deserted on November 22d, and no further history of the case is obtainable. The feces were negative for ova before desertion. During his stay in the hospital he gained forty-one pounds.

CASE VI.—G. C. D., aged twenty-one years; birthplace, Virginia; entereed this hospital October 31, 1902; diagnosis: ankylostomiasis. Patient's illness began in September, 1902. The only symptom he complained of at that time was diarrhœa, which continued until October 15, 1902. Upon admission the patient appeared somewhat anæmic, but otherwise about normal. He complained of constipation, flatulence,

and slight tenderness over the abdomen. The physical signs were negative, save for a distended abdomen. He was returned to duty on February 24, 1903. The feces were examined on November 11th, and a few *uncinaria* ova were found. On December 12th the feces were again examined, and were negative for the ova.

CASE VII.—W. D. C., aged twenty-two years; birthplace, Kentucky; entered this hospital October 31, 1902; diagnosis: ankylostomiasis. Patient's present illness began about July 1, 1902, the symptoms complained of being diarrhœa and general muscular weakness. Physical signs were negative, except for a slight anæmia. The only symptoms complained of by the patient while in the hospital were muscular weakness and pain over the right kidney. Had no diarrhœa while in this hospital, and gained eight pounds in weight. His feces were examined on November 1st, and a few *uncinaria* ova were found. The feces were again examined on November 15th, and no ova were demonstrable. Patient was returned to duty on December 2, 1902.

CASE VIII.—C. A. L., aged thirty-three years; birthplace, Sweden; entered this hospital January 8, 1903; diagnosis: ankylostomiasis. Patient's illness began August 28, 1902, as an attack of acute gastritis, which recurred on September 12, 1902. These attacks were followed by vertigo, tinnitus aurium, and dyspnœa on exertion. Upon admission to this hospital the patient complained of vertigo, tinnitus aurium, chronic nasal catarrh, and a cough. Physical examination showed anæmia, an acute bronchitis on both sides, and a distended abdomen. This patient still remains in the hospital, the infection being very persistent. From the time of entrance to the present time his feces have been examined repeatedly, and the ova persisted in them until June 20, 1903, despite all treatment. On January 24th he had a slight convulsion, which at that time was supposed to be epileptic in character. Since then he has had several epileptiform convulsions. Since entering this hospital he has gained thirty-one pounds, but still appears anæmic, and states that he is far from feeling well. The chief symptoms complained of have been those already mentioned, together with colicky pains in the abdomen, distention and flatulence, and more or less headache.

CASE IX.—H. E. M., aged twenty-four years; birthplace, Michigan; entered this hospital April 28, 1903; diagnosis: dysentery (chronic amœbic) and ankylostomiasis. The patient's illness began December 10, 1902, as a colic, which recurred frequently, usually just before meals. He stated that this was relieved by lying on the stomach for about three minutes. He also suffered from alternating diarrhœa and constipation. His condition on admission was very good, although he was slightly anæmic. Had had no signs of any digestive disorder for two weeks. His feces were examined on April 29, 1903, and a few *uncinaria* ova found. They were examined repeatedly after this period, but no ova were found. Patient was discharged from the hospital June 15, 1903, to duty. He gained five pounds in weight while in hospital.

CASE X.—G. B., aged twenty-seven years; birthplace, Victoria, B. C.; entered this hospital April 28, 1903, and still remains under treatment; diagnosis: ankylostomiasis. Illness began December, 1902, the chief symptoms being diarrhœa, the movements containing some blood and mucus. Patient also had severe abdominal pain and distention.

He had four such attacks of diarrhœa before going to hospital. Upon admission the patient presented no symptoms whatever of ankylostomiasis, the only thing present being a very slight anæmia. The feces were examined and a few ova were found. Are negative at present.

CASE XI.—G. C. C., aged twenty-eight yeras; birthplace, South Carolina; entered this hospital April 28, 1903; diagnosis: ankylostomiasis. Patient's illness began March, 1902, as a diarrhœa. Three days after commencement he passed considerable blood and mucus. The highest number of bowel movements has been thirteen in twenty-four hours, accompanied by severe abdominal pain. On admission the patient's general condition was fair, but there was considerable anæmia present. The chief symptoms complained of were flatulence and abdominal distention. He had a slight diarrhœa, bowel movements numbering three or four in twenty-four hours. Upon physical examination the heart was found to be somewhat irritable and irregular. A slight increase was noted in vocal fremitus over the upper portion of the right lung. The abdomen was distended and somewhat tympanitic, and the patient complained of slight soreness upon palpation. The feces were examined on May 6th and a few *uncinaria* ova were found. Repeated examinations have since been made, but were always negative. Patient still remains in the hospital under treatment.

CASE XII.—J. H. C., aged twenty-five years; birthplace, Germany; entered this hospital April 13, 1902. This is the only fatal case of *uncinaria* infection which occurred at this hospital. He entered the hospital from the Discharge Camp at Angel Island on April 13, 1902, and died April 15, 1902. As the patient became delirious soon after admission, no history could be obtained from him as to his previous condition. It was found upon examination that he had been a patient in this hospital from October 2d to October 14, 1901, with a transfer slip diagnosis of ankylostomiasis. At that time he was pale and cachectic in appearance, and his bowels were constipated. After a short stay in the hospital the patient was discharged. Upon entrance the patient was very anæmic, respirations were labored, there was a slight delirium, and upon a careful examination the spleen was found somewhat enlarged. About 1.30 A.M. on the night after admission he had a severe chill, which was not accompanied, however, by any rise in temperature. His respirations were very labored, and this condition continued until his death at 10 P.M. on the night of April 15, 1902. No examination of the feces was made at this time on account of the lack of opportunity.

The following is the record of the pathological findings in this case: Body that of a man aged twenty-five; well developed and very little emaciated; finger-nails not congested; very slight post-mortem discoloration over the dependent portions of the body; skin of a lemon-like hue; pupils dilated and equal.

*Thoracic and Abdominal Cavities.* Subcutaneous fat and muscular tissue appear normal. Pleural cavities are free from fluid. The liver reaches to the lower border of the last rib. The greater omentum reaches to the bladder and contains a large amount of fat. The mesenteric glands are considerably enlarged. The appendix lies upon the brim of the pelvis and appears normal. The abdominal cavity contains a small amount of clear, yellow fluid. The bladder is almost filled

with urine. Suprarenal glands appear normal, and upon section of the abdominal aorta no sclerosis is observed. All of the viscera appear nearly bloodless.

*Liver.* The liver measures 22½ x 27 cm. Weight, 960 grammes. It is very pale in color externally, the capsule is smooth, and the right lobe is slightly indented by the ribs. The gall-bladder is almost filled with dark olive-green bile, and no calculi are present. Upon section the cut surface of the liver is a very pale yellow in color; the lobules are, as a rule, indistinct, but some of them show slight venous congestion. The entire organ is extremely anæmic in appearance, the blood oozing from it being almost like water, the color index only 32.

*Spleen.* The spleen measures 15 x 7½ cm. Weight, 150 grammes. It is bright pink in color externally, the capsule is smooth, and the notches are distinct. Upon section the cut surface is dusky red in color, the Malpighian corpuscles invisible, and the interstitial fibrous tissue not increased in amount. The consistence of the organ is below normal.

*Pancreas.* The pancreas measures 18 x 3½ cm. Weight, 130 grammes. It is very pale in color externally, and upon section the cut surface is almost white. Very little blood is visible in the organ. The consistence is somewhat decreased.

*Left Kidney.* The left kidney measures 11½ x 6 cm. Weight, 200 grammes. The organ is very pale in color externally, somewhat lobulated in appearance, and the capsule smooth. Two small cysts are present on the upper end. Upon section the cut surface is very pale in color, the cortex and pyramids being indistinct; this is due, however, to the anæmia rather than to changes in the parenchyma of the organ. The cortex is slightly thickened and there is a large amount of fat at the base of the pyramids. The mucous membrane of the pelvis is not congested, and the capsule not adherent. There are a few small cysts found upon the anterior surface of the organ beneath the capsule.

*Right Kidney.* The right kidney measures 12 x 5 cm. Weight, 160 grammes. It is light pink in color externally, the capsule is smooth, and no cysts are present. Upon section the cut surface appears very anæmic, but the cortex and pyramids are distinct. The cortex is thicker than normal, and there is considerable fat at the base of the pyramids. The mucous membrane of the pelvis appears much congested; the capsule is not adherent.

*Lungs.* The left lung is crepitant throughout, the lower lobe showing considerable hypostatic congestion. Upon pressure on this lobe, a large amount of bloody serum oozes from it, the blood being very thin and of low-color index. The right lung is adherent to the chest wall over the lower lobe and the lower portion of the upper lobe by very firm adhesions. The organ is crepitant and somewhat œdematous. Upon section of the organ a large amount of serum oozes from it on pressure.

*Heart.* Pericardial cavity contains about 100 c.c. of clear, straw-colored fluid. The apex of the heart is formed by the left ventricle. The amount of extracardial fat is greater than normal. The extracardial bloodvessels are somewhat congested. Coronary arteries appear normal. Upon section of the left heart the left ventricle is seen to contain a small, slightly yellowish clot, the auricle containing a red clot. The mitral valve appears to be slightly thickened, but is com-

petent. The aortic valve appears normal, as does the aorta above the valve leaflets. The muscular wall of the left side of the heart is slightly increased in thickness and very anæmic in appearance. Upon section of the right heart the right ventricle is found to contain a red clot. The tricuspid and pulmonary valves are normal. The muscular wall is slightly thicker than normal and the muscle appears very anæmic. Weight, 620 grammes.

*Intestinal Canal.* The large intestine appears normal, save for an intense anæmia of the mucous membrane. Small intestine: the ileum appears normal, save for an intense anæmia of the mucous membrane. In the jejunum and the lower part of the duodenum numerous minute worms are found embedded in mucus and in the mucous membrane. Upon examination these worms are found to be *uncinaria* (*ankylostoma*) *duodenalis.* The worms are most numerous in the jejunum, only about twenty being found in the duodenum. The entire number of worms counted amounted to 280, but they were probably much more numerous, as in opening the intestine a considerable portion of the mucus in which most of the worms were embedded was washed away. The proportion of males to females was about 1 : 4. About two-thirds of the worms are embedded in mucus, which in many places is slightly blood-stained. A considerable number, however, are attached to the mucous membrane and upon being separated a small ecchymotic spot is observed at the point of attachment. These minute blood-stained areas are especially numerous in the jejunum. The entire mucous membrane is intensely anæmic in appearance, and in many places there is an almost total atrophy of the *valvulæ conniventes.*

The stomach appears normal, save for an intense anæmia of the mucous membrane.

*Anatomical Diagnosis.* Secondary anæmia due to *uncinaria* (*ankylostoma*) *duodenalis.* Subacute parenchymatous nephritis. Ascites. Hypostatic congestion of the lungs. Œdema of the pericardium and slight venous congestion of the liver.

*Microscopic Examination.* Upon microscopic examination of the viscera, no characteristic lesions could be determined. The mucus in the intestinal canal showed numerous ova and almost invariably red blood corpuscles. Examination of the worms found showed them to belong to the European species.

ANALYSIS OF SYMPTOMS. *General Development.* In all the cases observed at this hospital the disease occurred after the period of adult life was reached, and, therefore, the lack of development noted by various authorities in persons in which the disease had occurred in early life was absent. All the patients were well-developed men, but emaciation was present in about half the cases.

*Skin.* In all of the cases a marked anæmia was present, the skin appearing of a pale, somewhat lemon-tinted color. In none of the cases was there observed the shrivelled appearance of the skin described by Stiles.[1] In one case the skin was of a normal white color.

*Head.* In none of the cases observed at the hospital did there appear to be any œdema of the face, which has been noted as a common symp-

[1] Bull. No. 10, Hyg. Lab., U. S. Pub. Health and Mar. Hosp. Serv., Washington.

tom by most authorities; neither could it be determined that the face had the anxious or stupid appearance which Stiles[1] speaks of.

*Eyes.* In his elaborate article upon uncinariasis, Stiles[2] notes the following symptoms affecting the eyes: The pupils either are dilated or they dilate readily, while the conjunctiva appears dull, dry, and of a chalky white. He also calls attention to the following phenomena observed by staring directly into the patient's eyes, he, meanwhile, looking intently at the investigator. Stiles says: "After a moment, the length of time apparently varying slightly according to the length of the disease, the pupils dilate and the patient's eyes assume a dull, blank, almost stupid, fish-like, or cadaveric stare, very similar to that noted in cases of extreme alcoholic intoxication." He states that he noted this peculiar condition in all the cases of uncinariasis he observed except two, and that he failed to find this condition in patients suffering from anæmia not due to this disease. He, however, does not go to the extent of stating that this stare is diagnostic of the disease. In the cases which have occurred here I have investigated this symptom and agree with Stiles in finding that it is present in almost all cases; only one case observed here failed to present it.

*Conjunctivæ and Mucous Membranes of Nose, Lips, and Gums.* In all the cases observed there was a marked anæmia of the conjunctivæ and the mucous membranes of the nose, lips, and gums. This was more noticeable, of course, in the most severe cases.

*Tongue.* In all but one of the cases observed here the tongue appeared clean, the only exception showing a brownish-yellow fur, rather thick, with small purplish-black areas scattered along the dorsum of the tongue. These spots were, as a rule, circular in shape and appeared to extend into the epithelial lining of the tongue. Some authorities have laid special emphasis upon these blackish spots as being diagnostic of the disease. From my experience here I would not consider these spots as of much significance, for only one out of twelve cases presented them, and I have observed the same condition in cases of dysentery, tuberculosis, and valvular disease of the heart. I believe the spots to be due, in all probability, to a venous stasis in the affected areas.

*Trunk.* The cervical pulsations were very distinct in nine of the twelve cases, so much so that they could be observed at some distance. The thorax did not present anything characteristic of the disease. The abdomen presented one of the most characteristic physical signs of uncinariasis, this condition being present in every case observed here. This characteristic physical sign is *distention* of the abdomen, giving the appearance commonly known as "pot-belly." This distention is

[1] Loc. cit. [2] Loc. cit.

due to an accumulation of gas in the intestines, caused by lessened peristaltic action, and in some cases it is further aggravated by the accumulation of fluid within the abdomen.

Upon palpation of the abdomen, tenderness over the region occupied by the stomach, transverse colon, and small intestine was present in nine of the twelve cases, the epigastric tenderness being most marked.

In four of the cases distended venules were present over the abdominal wall, giving the abdomen a marbled appearance.

*Extremities.* Only one case observed at this hospital presented any symptoms which could be referred to the extremities. This one case showed a slight œdema of the ankles. According to most authorities, œdema is a common symptom in the worst cases of this disease, but in the case here in which œdema of the ankles was present the infection was a comparatively mild one. In the only fatal case occurring here œdema of the extremities was not present, although there was considerable ascites.

*Respiratory System.* One of the most common symptoms present was dyspnœa, especially prominent during exertion. Every case observed complained of this symptom, and in three of the cases it was so severe as to occasion the patient's great agony. In these latter cases the condition seemed to come on in paroxysms after even the slightest exertion. As regards the number of respirations, there seemed to be no general rule which could be deduced. In some of the cases the respirations were slower than normal, but in a larger number the respirations were above normal, varying between twenty and forty per minute. Only one of the cases observed here presented any symptoms of bronchitis, in this case the condition being a very prominent symptom. I do not believe, however, that the bronchitis was anything more than an accidental complication.

*Circulatory System.* The symptoms most prominent were anæmia, the cervical pulsations, palpitation and irregular action of the heart, hæmic murmurs, pain over the region of the heart, and irregularity in force and frequency of the pulse. *Anæmia* was present in eleven of the twelve cases. It varied in intensity, being, of course, most severe in the long-continued cases of well-marked infection. As the blood counts in these cases will be given later, I shall not consider the numerical decrease at this time. As has been mentioned, the anæmia was most easily observed in the mucous membranes, especially the conjunctivæ and the lips. The lemon-yellow hue of the skin has also been mentioned. Palpitation and irregular action of the heart were present in six of the cases. This condition was complained of in only two of the cases. Hæmic murmurs were present in eight of the cases. In seven the murmurs were most noticeable over the carotids, and in only one was a murmur distinguishable over the heart. All of these cases showed a

considerable degree of anæmia. Pain over the region of the heart, characterized by the patients as a sense of pressure, was present in two cases. All the patients showing anæmia presented some irregularity in the force and frequency of the pulse. In all of them the force of the pulse was decreased, but it was noticed upon keeping the fingers on the pulse for some time that there were periods in which the pulsations were much more forcible. In six of the cases the frequency of the pulse was increased, varying from ninety to one hundred and ten. In two of the cases the pulse ranged between forty and fifty per minute.

*Nervous System.* Headache was one of the most prominent symptoms complained of by these patients. It occurred in all of the cases showing severe anæmia, and was severe according to the extent of the anæmia. It seemed to be somewhat paroxysmal in character and was located, as a rule, in the frontal region or the occiput. In only one case was delirium observed, this case being the one that proved fatal. A condition of mental apathy was observed in six of the cases. This did not amount to an actual inability to comprehend, but seemed to be rather more of a disinclination to exercise the mental faculties. In his comprehensive article, Stiles[1] calls special attention to this condition, which, associated with the muscular weakness that is almost always present in these cases, produces a condition of laziness, which he considers the prominent symptom of uncinariasis in the Southern States. His announcement of this fact, unfortunately, gave rise in the daily papers to the statement that the organism of laziness had been discovered. Tinnitus aurium was present in two cases, and was very annoying to the patients. Vertigo was present in six of the cases, all of which showed marked anæmia. Neuralgic pains, referable to various portions of the body, were present in five of the cases. The pain was most frequent in the knee-joints and shoulders. All the patient showing anæmia spent a large portion of the day in sleep, and, from my experience, I believe that this is a valuable symptom of uncinariasis.

*Digestive System.* The chief symptoms referable to this system were nausea and vomiting, abnormal appetite, constipation or diarrhœa, and colicky pains in the stomach and bowels. Nausea and vomiting were observed in but one case, and were evidently due to a chronic gastritis. Disturbances in the appetite of the patient were observed in six of the cases, in all of which there was an abnormal craving for food. This condition led to a disagreeable sensation of emptiness and distention in the stomach. Marked flatulence was present in ten of the cases, and would appear to be a very common symptom of the disease. As far as can be ascertained from the records of the cases, there was no perversion of the appetite noted, none of the patients asking for unusual

[1] Loc. cit.

articles of food, nor did any of them give a history of dirt-eating. Constipation and diarrhœa were frequent symptoms in the cases observed here. Diarrhœa was present in six, constipation in four, and the bowel movements were normal in two. It was not possible to determine whether or not the first attack of diarrhœa in those cases showing it was due to the *uncinaria*. As regards the stage of the disease in which the symptoms are most frequent, I would say that diarrhœa is most frequent in the early stages and constipation in the later stages. In some of the cases, however, diarrhœa persisted until remedial measures cured the infection. Every one of the cases observed here complained of colicky pains in the stomach and bowels. This condition was always associated with a distended abdomen, and was present from the very commencement of the infection. The colic occurred, as a rule, shortly after eating, and just before the movements of the bowels. I believe that the two most characteristic symptoms associated with the digestive system are distention of the abdomen and colic. Two of the patients complained of a severe throbbing pain over the stomach, and in both these cases there was present, in addition, very severe abdominal colic.

*Muscular System.* In five of the cases marked emaciation was present, being especially noticeable in the extremities. The remaining seven cases did not show any emaciation worthy of notice, but in all the cases the muscles were flabby and there was great muscular weakness present. A dull ache in the muscles was complained of, especially noticeable on awakening in the morning and after any continued exertion. There was also present a lack of inclination to exercise, and if exercise was taken the patient tired very easily.

*Temperature.* In only two cases was there any rise in temperature noted. In one the temperature oscillated between normal and 100° F., and in the other, the fatal case, between 100° and 103° F., the latter point being reached just before death. I am unable to state that the remaining cases did not show any temperature, because the clinical data is not clear upon this point, but it is probable that in the cases showing marked anæmia the temperature varied in the same manner as it does in other cases of severe anæmia.

*Urine.* The urine did not show anything characteristic, being normal in every case except one, this being the fatal case. Just before death the urine showed considerable albumin and numerous hyaline and granular casts, together with pus cells.

*Feces.* In the cases showing diarrhœa the feces were of semifluid consistence or fluid, varying in color from a light gray to dark brown, always contained mucus, and generally some blood. The majority of the specimens were of a dark-brown color, and contained considerable blood-stained mucus. In the constipated cases the feces were well

formed, and of a dark-brown color, also showing mucus. It was found that it was much easier to demonstrate the *uncinaria* ova in the formed feces than in the semifluid or fluid. In fact it required several examinations to demonstrate them in the fluid feces, and then they could only be found in very small numbers. In the portion of this report dealing with the diagnosis of the disease, I shall discuss more fully the methods of examination of the feces.

*Blood.* In every case showing anæmia the blood was of a more fluid consistence than normal, in the worst cases being almost like water. The color in the worst cases was almost buff, while those cases which did not show so extreme a degree of anæmia exhibited a gradual gradation from this very light buff color to the normal color of the blood. It was noticed that the blood coagulated very slowly, and in the fatal case coagulation did not occur until nearly half an hour elapsed from the time of taking the blood.

*The Hæmoglobin.* Stiles,[1] in his valuable report, states that the hæmoglobin is more apt to be reduced in the early stage of the disease than in the later, and that the most chronic cases are more apt to have a high hæmoglobin average than are the acute. This statement has been well borne out in the cases observed at this hospital, as the following table will show:

| Case. | Duration of infection. | Hæmoglobin. |
|---|---|---|
| 1 | 3½ months. | 36 per cent. |
| 2 | 27 " | 68 " |
| 3 | 10 " | 48 " |
| 4 | 4½ " | 34 " |
| 5 | 3 " | 30 " |
| 6 | 2 " | 82 " |
| 7 | 4 " | 40 " |
| 8 | 5½ " | 45 " |
| 9 | 4 " | 28 " |
| 10 | 5 " | 50 " |
| 11 | 13 " | 60 " |
| 12 | about 2 years | 20 " |

As will be seen, the statement is borne out in every case except Case XII. This was the fatal case, and the patient undoubtedly died of a profound secondary anæmia, and, as will be seen by the blood counts which follow, the hæmoglobin was not very much reduced beyond the reduction in the red cells.

*The Red Blood Corpuscles.* In ten of the twelve cases which have occurred here poikilocytosis was present, and most marked in the cases which showed the most severe degree of anæmia. Numerous authorities have claimed that poikilocytosis is not, as a rule, present in the blood in cases of uncinariasis, but this has not been our experience here, nor was it the experience of Ashford,[2] who found that it was present in

[1] Loc. cit.

[2] Cabot. Examination of the Blood.

sixteen of his seventeen cases occurring in Porto Rico. Normoblasts and megaloblasts were present in eight of the cases, but in very small numbers. The reduction in red cells will be seen in the table of blood counts which follows.

*The White Corpuscles.* Differential counts were made of the white corpuscles, and the following facts were observed: first, that there was invariably an increase in the eosinophiles; and, second, that the polymorphonuclear neutrophiles were reduced in proportion to the increase of eosinophiles. These facts agree with Ashford's statements in regard to the white corpuscles.

The eosinophiles in all the cases showed a marked increase, but this is not at all diagnostic of uncinariasis. In my experience, it is observed in nearly all cases of infection due to animal parasites. Thus, it is present in tapeworm infections, *strongyloides* infections, trichinosis, and is a very common condition in amœbic dysentery. While it should arouse our suspicions, the mere presence of eosinophiles is not at all diagnostic of uncinariasis.

The following table gives the blood counts in the cases observed at this hospital. The lowest blood count and hæmoglobin estimate observed here is given and the highest eosinophile count:

| Case. | White cells. | Red cells. | Eosinophiles. | Hæmoglobin. |
|---|---|---|---|---|
| 1 | 3,572,000 | 23,000 | 8 per ct. | 36 per ct. |
| 2 | 2,160,000 | 16,000 | 5 " | 68 " |
| 3 | 2,100,000 | 9,000 | 1.5 " | 48 " |
| 4 | 3,650,000 | 12,000 | 6 " | 34 " |
| 5 | 1,252,000 | 10,000 | 3 " | 30 " |
| 6 | 1,848,000 | 31,000 | 10 " | 32 " |
| 7 | 1,550,000 | 26,000 | 12 " | 40 " |
| 8 | 1,560,000 | 11,000 | 15 " | 45 " |
| 9 | 4,160,000 | 62,000 | 1.4 " | 28 " |
| 10 | 4,000,000 | 10,000 | 3 " | 50 " |
| 11 | 3,417,000 | 10,000 | 2 " | 60 " |
| 12 | 810,000 | 11,000 | 15 " | 20 " |

As will be observed, leucocytosis occurred in all but one of the cases. This is not in accordance with the observations of most authorities, and is very hard to explain. The counts were made very carefully, and there could be no mistake in the results obtained. It may be that the change from a tropical climate to a cool climate, such as San Francisco, may account for the rise in leucocytes. Two of the cases observed were complicated with malaria, one showing a tertian æstivo-autumnal infection, and the other a tertian infection.

There was no increase noticed in the large or small lymphocytes, nor were any myelocytes observed.

DESCRIPTION OF THE PARASITES. All of the cases observed here were infected with the old-world hookworm, *i. e.*, *anchylostoma duodenale* or *uncinaria duodenalis*. None of the cases observed were infected with the new-world hookworm, *uncinaria americana*. As

the differentiation of these two parasites is of importance, I shall give Stiles' description of both.

"The old-world hookworm, *unicaria duodenalis:* Body cylindrical, somewhat attenuated anteriorly; buccal cavity, with two pairs of ventral teeth curved like hooks and one pair of dorsal teeth directed forward; dorsal rib not projecting into the cavity. Male, 8 mm. to 11 mm. long; caudal bursa, with dorsomedian lobe and prominent lateral lobes united by a ventral lobe; dorsal ray divides at a point two-thirds its length from its base, each branch being tridigitate; spicules long and slender. Female, 10 mm. to 11 mm. long; vulva at or near posterior third of body. Eggs, ellipsoid, 52$\mu$ to 60 x 32$\mu$, laid in segmentation. Development direct without intermediate host.

"The new-world hookworm, *uncinaria americana*, Stiles, 1902, of man: Body cylindrical, somewhat attenuated anteriorly; buccal capsule, with a dorsal pair of prominent semilunar plates or lips and a ventral pair of slightly developed lips of the same nature; dorsal conical median tooth projects prominently into the buccal cavity. Male, 7 mm. to 9 mm. long; caudal bursa, with short dorsomedian lobe, which often appears as if it were divided into two lobes, and with prominent lateral lobes united ventrally by an indistinct ventral lobe; common base of dorsal and dorsolateral rays very short; dorsal ray divided to its base, its two branches being prominently divergent, and their tips being bipartite; spicules long and slender. Female, 9 mm. to 11 mm. long; vulva in anterior half of body, but near equator. Eggs, ellipsoid, 64$\mu$ to 76$\mu$ long by 36$\mu$ to 40$\mu$ broad, in some cases partially segmented in utero, in others (rare), containing a fully developed embryo when oviposited."

*Habitat.* In small intestine of man.

As will be seen, the chief differences from a practical standpoint between these two worms consists in the vulva in the female of *uncinaria duodenalis* being situated at or near the posterior third of the body, while in the *uncinaria americana* it is situated in the anterior half of the body, the armature of the mouth, the buccal cavity in the *uncinaria duodenalis* having two pairs of ventral teeth and one pair of dorsal teeth projecting forward, while in the *uncinaria americana* the buccal capsule is provided with a dorsal pair of semilunar plates or lips, and a ventral pair of slightly developed lips of the same nature, and a dorsal conical median tooth projecting prominently into the buccal cavity, and in the size of the eggs. The eggs of the *uncinaria americana* measure from 64$\mu$ to 76$\mu$ long by 36$\mu$ to 40$\mu$ broad, while in the *uncinaria duodenalis* the eggs measure 52$\mu$ to 60$\mu$ long by 32$\mu$ broad. It will thus be seen that the eggs of the American specimen are much larger than those of the European.

*The Ova.* I shall describe here only the ova of the European species, as all of my cases were infected by this variety of the parasite. The ova are deposited in the intestinal tract of the patients and are discharged in the feces either unsegmented or partially segmented.

These ova are of the measurements already named, are ovoid in shape, enclosed by a thin, hyaline-appearing, and very distinct membrane. This membrane never appears of a double outline, and is generally perfectly regular unless the ova are degenerated. Within this hyaline-appearing membrane, and placed at some distance from it is a granular mass of material which, at various stages of the development of the ovum, exhibits differences in structure. In those ova in which segmentation has not begun this granular mass appears homogeneous in structure, but where segmentation has commenced the mass is divided into more or less numerous granular clumps according to the stage of segmentation. When well advanced each granular clump or cell will be seen to consist of a granular protoplasm surrounding a small hyaline-appearing nucleus. The granular material consists of very distinct, refractive granules, much larger than those which occur in the protoplasm of any of the cells of the human body. As segmentation advances, a complete embryo is finally formed, but the ova escaping in the human feces never show any embryos within them, this development occurring after the feces have been exposed for some time to the air. It should be remembered that the ova of *uncinaria* never develop into embryonic worms within the intestine, it being necessary that they should first be deposited externally to the body. It therefore follows that for every adult worm present in the human body a separate embryo must have entered it.

METHODS OF INFECTION. Probably the most important method of infection is by swallowing the worms in infected food or drinking water. One very common method of infection occurs in persons who handle dirt in infected localities, and, because of uncleanly habits, contaminate their food or convey the infection directly to the mouth with the hands.

A method of infection which has received much study is that through the skin. This theory, which has now become established, was first announced by Looss. He discovered that if water containing embryos of *uncinaria* was placed upon the skin an itching sensation was produced, due to the worms entering the hair follicles, from which region they entered the surrounding tissues. At first this theory was received with a great deal of skepticism, especially when he announced that from the skin the larvæ finally reached the intestinal canal. Despite this skepticism, however, Looss has absolutely proved by experiment that this actually occurs, and not only by experiment on the lower animals but upon man himself. He found that in the case of a man who offered himself for such experiment, his feces having been examined for weeks previously, the application of infected material to his arm resulted in the appearance of the ova of *uncinaria duodenalis* in the feces on the seventy-first day.

By the experiment of Bentley the condition known as "ground-itch," occurring in some tropical regions, has been shown to be probably due to infection with uncinaria. This, however, has not been definitely proven, but is worthy of attention.

The theory propounded by some authorities that the larvæ of *uncinaria* can reach the human being through the respiratory tract, being present in the air, has not received any definite proof, and, so far as the present status of the case is concerned, it is not a probable method of infection.

*Diagnosis.* The diagnosis of uncinariasis (ankylostomiasis) depends upon the finding of the ova of the parasite in the feces. While the clinical symptoms are in some degree characteristic, they are not sufficiently so as to render a diagnosis of this infection conclusive by reference to them alone.

Methods of Examination. The best method of examining the feces for the ova is to select a small portion which is smeared upon a clean glass slide, if necessary, mixed with a little water and covered with a cover-slip. The specimen should be examined with a 1/6 objective and a one-inch eye-piece. Care should be taken not to have too much light upon the object, and, if the examination is not positive, several slides should be prepared and examined. To one who has seen the ova it is impossible to mistake them for the ova of any other intestinal parasite. Those most apt to be mistaken are the eggs of *ascaris lumbricoides, oxyuris vermicularis,* and *strongyloides intestinalis.* No difficulty will be experienced in differentiating the ova if any good work upon the intestinal parasites is consulted.

In certain cases, especially in those in which the feces are of a fluid consistency, or where the ova are in very scarce numbers, some method of sedimentation is necessary to demonstrate them. The method I prefer is as follows: A small quantity of the feces is taken and mixed with the requisite quantity of distilled water to make a very fluid consistence. This mixture is then placed in a centrifuge and allowed to rotate for from three to five minutes. The liquid is then poured from the top of the tube, and with a slender pipette some of the sediment is obtained from the very bottom of the tube. This is then placed upon a slide, diluted, if necessary, with sterilized water, and examined. If the ova are present this method will almost invariably demonstrate them.

Where a centrifuge is not obtainable the method of sedimentation recommended by Stiles[1] is most valuable. This consists in taking one or two ounces of feces, adding enough water to make from a pint to two quarts, shaken thoroughly, and the floating matter poured off, as well as the water down to the sediment. This washing is repeated

[1] Loc cit.

several times until no floating matter is observed. The last time it is done the mixture is poured into a small conical graduate, and after settling the sediment is examined.

In examining feces for *uncinaria* ova it will be found that the well-formed stools are most liable to result positively, and in such cases a small portion of the feces should be taken from the surface of the stool and, if possible, from any mucus present.

Where there is any doubt as to the presence of *uncinaria* ova in a given specimen it is well to place the feces in an incubator and to examine it after from twenty-four to thirty-six hours, when the young embryonic worms will be found.

*Blotting-paper Test.* Stiles[1] recommends this test when the microscopic examination of the feces is impossible. It consists in placing a small portion of the feces upon white blotting paper and allowing it to remain for from twenty minutes to several hours. Upon removal "it leaves upon the paper a reddish-brown stain, similar to a blood stain." This method, while it may be practicable in a certain class of cases, is, it seems to me, of very limited application. I have found that the feces from a large number of various disease processes will leave a brown stain upon blotting paper, and this is especially true of the very class of cases in which a differential diagnosis is of most importance. Thus, the feces of chronic diarrhœa, chronic dysentery, both amœbic and specific, and chronic colitis often give a brown stain on applying this test. If a diagnosis of uncinariasis was made in such cases, it will be seen how incorrect and injurious to the patient it would be. Certainly in the class of cases received at this hospital this test is of little or no value.

*Prognosis.* It may be said that, as a rule, the prognosis in cases of uncinariasis is favorable if properly treated. To be sure, deaths often occur from this disease, but it will be almost invariably found that such cases have not received treatment, or, if treated, that the measures taken have not been thorough. That the disease is not one which is very dangerous to life is shown by the large number of cases in which the infection has lasted for years, but on account of the great debility produced by it this infection is of great economic importance. One has only to read in the valuable report of Stiles the condition produced in a certain class of the population of our Southen States by this infection to realize at once the great importance of its prevention.

*Treatment.* I have had no experience in the treatment of this infection, and can only speak from the experience of others. I believe that it is the concensus of opinion that *thymol* is the best drug as yet discovered for the treatment of this disease. It is usually given in the

[1] Loc. cit.

following manner: The patient is kept in bed for a day or two before the drug is administered, and on as light a diet as possible. At the end of this time one gram (fifteen grains) of thymol is administered, followed in about two hours by the same dose. After from two to six or eight hours or longer a saline cathartic is administered, preferably magnesium sulphate. The stools should invariably be examined for the worms, as otherwise no statement can be made as to the result of the treatment. Larger doses of thymol are advocated by many; thus, two grams may be administered at once, followed by another two grams in two hours. The stools should be examined again in a week, and if, after repeated examinations, no ova are found, a cure may be expected. If, however, the ova are found, the treatment should be repeated.

Numerous instances are on record in which thymol produced alarming symptoms, and some authorities, notably Sandwith, believe that death has occurred from the use of this drug. It should be given with caution, and for this reason I have recommended the smaller dose. In one case which I observed here I believe that the drug caused a marked depression of the heart, which almost ended in collapse.

In all but one of the cases treated here, excepting the fatal case, the use of thymol resulted in a complete and rapid recovery. In this one case, however, repeated treatment with the drug has been pursued over a period of six months, and the ova of the parasite are still present, although in smaller numbers in the feces.[1]

In the general discussion of treatment of this disease it is proper to speak of the methods to be adopted for its prevention. So far as the army is concerned, these methods consist in the proper disposal of the excreta, careful attention to the cleanliness of the person, especially the hands, the wearing of shoes in regions in which the natives are infected, and the boiling of the drinking water.

As the ova of this parasite develop in the feces after they have been voided, it will be at once seen how necessary the proper disposal of such matter is. The various methods of such disposal are well known to army surgeons, and will not be discussed.

As in a large majority of the cases infection is undoubtedly due in the human being to uncleanly habits, particularly eating with dirty hands, too strict attention cannot be paid to this item of personal cleanliness. The hands should invariably be washed before each meal, and, if possible, in hot water.

As Looss has shown that the infection can travel through the skin to the intestinal canal, it is obvious that going barefoot in an infected locality may lead to infection. Therefore, in such localities, shoes should be always worn.

[1] Since writing the above the ova have disappeared and the patient has been discharged from the hospital.

It is unnecessary to speak of the importance of boiling the drinking water, as this is so necessary a procedure in tropical climates, and also in many regions where water-borne disease is suspected, that it is invariably carried out whenever possible. Where the boiling of the water is impracticable, some method of filtration or sterilization should be adopted.[1]

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## TUBERCULOSIS OF THE TONSILS AND THE TONSILS AS A PORTAL OF TUBERCULAR INFECTION.

By Henry Koplik, M.D.,
of New York.

The tonsils have long been a subject of investigation as a seat of tuberculosis, and the literature is quite voluminous on this theme. Orth and Cohnheim first called attention to the fact that these organs might not only be the seat of tuberculosis, but that they were potent factors in the dissemination of this infection throughout the body. The observations on tuberculosis of the tonsils and the conclusions drawn from them differ because one set of observers has studied the disease from a purely clinical standpoint, while the other has analyzed pathological and autopsy material. Pluder and Fischer examined a number of hypertrophied tonsils excised from the living subject; recently Lartigau and Nicoll examined a large number of adenoids. Any conclusions drawn from such material must necessarily be imperfect, for concealed tuberculosis elsewhere in the body would escape confirmation. Tuberculosis of the tonsil may be a primary isolated process unaccompanied by tubercular foci elsewhere. This is exceedingly rare; the only case of the kind in the later literature is that of Friedmann. In this case the patient was one year and four months of age; the tonsil alone was affected, the child dying of other causes. Other authors (Orth, Ruge, Schlessinger, Scheibner, Kruckmann) speak of primary tuberculosis of the tonsil with accompanying tuberculosis of the cervical lymph nodes. In these cases the disease was limited to these organs, or may have spread thence and then involved other organs. In one case published by Ruge the tuberculosis involved the tonsil and lymph nodes of the neck and caused also secondary cervical spondylitis, the lungs having escaped. Other cases are published by Schlenker, Brugmann, Friedmann, and Orth, in which the tonsillar affection was the starting point of an acute miliary tuberculosis or of a chronic pulmonary tuberculosis of the lung. The secondary forms of tuberculosis of the tonsil

[1] Since writing this report six more cases of uncinaria infection have been observed here, all infected with the European species.

are very common (Strassmann, Ruge, Dmochowski, Schlenker). The victims of chronic pulmonary tuberculosis sooner or later develop tonsillar infection. This form of tonsillar tuberculosis is only of passing interest. In both the primary and secondary forms of tuberculosis of the tonsil the cervical lymph nodes are quite constantly affected. Children furnish by far the greatest quota of cases, not only of primary tonsillar tuberculosis, but the form of the disease in which the tonsil draws into the infection the cervical lymph nodes. In some cases the tonsil is to external appearances normal; in others it may be hypertrophied (Lewin, Pluder, Fischer), the external surface showing no erosions or ulcerations. In a few cases the affected tonsils were even atrophied (Walsham). These atrophied tonsils when examined were found, as in the other forms mentioned, to contain tubercle tissue and tubercle bacilli. Ulcers on the tonsil of a tubercular nature have only rarely been observed. In all the forms the cervical lymph nodes may be enlarged. When such is the case, the largest nodes and those supposedly first infected are found high up behind the tonsil. The affected nodes form a packet, stretching from behind the angle of the jaw along the great vessels toward the clavicle. The youngest diseased nodes are found behind the great vessels in chains. They are often very numerous. The cases of primary tuberculosis of the tonsil confirmed by autopsy in the later literature may be summarized as follows:

One case mentioned in this paper of isolated tonsillar tuberculosis in a young child observed by Friedmann. Two other cases by the same observer of tonsillar tuberculosis with involvement of the cervical lymph nodes. Two cases in children of Kruckmann, with tuberculosis of the cervical lymph nodes. Two cases by Schlenker of tuberculosis of the tonsil and the accompanying lymph nodes in adults. Four cases of 60 examined by Scheibner of possible primary tuberculosis. One case by Ruge, mentioned above, in a girl aged eighteen years. Pluder and Fischer, on the other hand, examined the tonsils of 32 patients which had been excised for hypertrophy and found tubercular infection in 5. Lartigau and Nicoll found 10 per cent. of 85 adenoids were the seat of tubercular tissue and bacilli. These were mostly children, the tonsils alone being examined. The other organs clinically revealed no tuberculosis. These authors give a résumé of 161 cases of Lermoyez, Gottstein, and Brindel examined in the same way. In 19 of these cases the tonsils were found to be tubercular and to contain tubercle tissue and bacilli. In those cases in which the excised tonsils alone are examined, the diagnosis of primary disease of the tonsil must necessarily be only provisional. In this respect such investigations must remain incomplete. It must be admitted, however, that if changes in the tonsil are old, the presumption of primary nature of the disease is strong in the absence of marked signs of affection of the lungs or

other organs. In this sense only the author wishes to report in this connection a case of apparently primary disease of the tonsil, peculiar in that the development of the affection dates distinctly from an exposure to infection. Both tonsils were involved. One tonsil showed a distinct tubercular ulceration which is rare, resembling in some respects a chronic diphtheria. Scrapings from the tonsillar ulcer revealed large numbers of tubercle bacilli. The granulations scraped from the tonsil showed tubercle with giant-cell formation. Examination of the extirpated tonsil on the left side showed the same tissue and bacilli. The lymph nodes on both sides of the neck from the angle of the jaw down were much enlarged, and when extirpated and examined showed the presence of cheesy areas, tubercle tissue, and numbers of tubercle bacilli. The nodes showing the oldest infection were high up behind the tonsil.

A. W., male, child, aged fifteen months; only child. Father and mother in good health. Patient has hitherto been in good health, with only an occasional bronchitis. Last summer, 1902, the parents took the child to Liberty, N. Y. The grandfather was stopping at this place, suffering from pulmonary tuberculosis. The child was with his grandfather quite a good deal and ate at the same table. In November, 1902, the child began to suffer from what the physician called tonsillitis. It was at this time in the city. In January, 1903, I saw the patient for the first time. The child was well nourished, slightly rachitic. It had congenital stridor. There was enlargement of both tonsils, especially the left. On this tonsil there was a ragged yellow ulcer, with an appearance resembling a pseudomembranous exudate. There were adenoids. At this time I found no bronchitis, no lung lesion. The cervical lymph nodes at the angle of the jaw were much enlarged. The color of the child was good. There were no enlarged nodes elsewhere. The patient with ordinary treatment for a tonsillitis improved. The pseudomembranous appearance of the ulcer on the left tonsil persisted for a time and then cleared up. The nodes at the angle of the jaw continued enlarged. Extirpation of the tonsils and adenoids was advised and carried out. On cutting the left tonsil, it was noticed that there was considerable resistance to the tonsillotome. As the surgeon expressed it, the tonsil had a cartilaginous consistency. After the operation the lymph nodes did not diminish in size—on the contrary. The old ulcer and pseudomembranous coating reappeared on the left tonsil four weeks after the operation. Scrapings taken from the ulcer on the left tonsil showed tubercle bacilli in large numbers, and the tissue scraped from the tonsil showed the structure of tubercle tissue. At this time the general condition of the child had improved and the patient had not lost in weight. The lungs did not show any areas of dulness. On the right side behind, over the lower portion of the lung, there were at times a few coarse râles (bronchitis?). There were at this time no enlarged glands elsewhere in the body; spleen and liver of normal size.

*March* 10. Nineteen pounds in weight a month after operation for adenoids and enlarged tonsils. Child had gained a pound in the past

month. Extirpation of the cervical lymph nodes on both sides and tonsil on left advised and carried out. The extirpated nodes on both sides were much enlarged, the oldest and largest nodes being behind the tonsil on both sides; the affected nodes stretched in a pocket as far as the clavicle.

The enlarged nodes on examination were seen to be the seat of tuberculosis. There was typical miliary formation of tubercle tissue with giant cells and numerous tubercle bacilli in the tissue. The lymph nodes on both sides showed the same pathological changes. Sections of the left tonsil showed tubercle tissue, though no cheesy areas, with very abundant tubercle bacilli.

The pathological examination was carried out by Dr. C. S. Bernstein, assistant pathologist of the Mount Sinai Hospital. Patient was examined two weeks after operation. The wounds on both sides were fast closing; the left wound had closed by primary union. The child, however, looked as if it had been through a severe operation. The lungs showed no areas of dulness, no bronchitis. There were no enlarged nodes elsewhere.

Two weeks later there was a loss of three pounds in weight, as compared to weight of the child previous to the operation. There was marked dulness over the lower lobe of the right lung behind. From the physical examination, therefore, there would seem to have been an invasion of the lung. The child died three weeks later with signs of pulmonary tuberculosis of the right lung and also of the larynx.

In the following case there was a packet of tubercular lymph nodes on the left side of the neck, without any accompanying lesion which could be demonstrated clinically. The enlargement of the lymph nodes dates from an affection of the tonsil. At the time of consultation the tonsil on the side of the affected lymph nodes was rather small, with an apparently normal surface. When removed the lymph nodes were found to be cheesy, broken-down, containing numerous tubercle bacilli. The largest nodes were just behind the angle of the jaw, adherent to the sheath of the internal jugular vein. A large number of small red nodes were extirpated, stretching in a chain behind the great vessels of the neck on the left side toward the clavicle. The nodes examined were found to be tubercular. The tonsil was not examined.

R. G., female child, aged twelve years. Father dead; cause? Mother in good health. Four other children in the family. A child younger than the patient is a delicate child nine years of age, seen by me in consultation. The diagnosis of lymphatism was made. Child ran a slight temperature, at times one degree above the normal toward evening. The only changes found were very slightly enlarged axillary lymph nodes, inguinal nodes, and cervical nodes. The patient, a sister of the above, had scarlet fever about a year before her visit, followed by an attack of diphtheria. Three months before the visit the mother noticed that the cervical lymph nodes on the left side at the angle of the jaw were enlarged. They have increased in size and now are as large as a walnut. Examination shows this mass to be made up of a number of lymph nodes. There are no enlarged nodes elsewhere. The examina-

tion of the lungs shows nothing positive. The percussion over the left apex in front seems slightly higher in pitch, but there are no râles and there is no change in the voice or breathing. The tonsils are normal in size and appearance. Weight of child seventy-one pounds. Slightly anæmic.

Hæmoglobin, 65.7 per cent.; white blood corpuscles, 12,300; red blood corpuscles, 4,088,000; lymphocytes, 34.2 per cent.; large mononuclear, 1.6 per cent.; polynuclear neutrophiles, 63.4 per cent.; mast-cells, 0.8 per cent.

Extirpated packet of a number of enlarged nodes and smaller ones showed that the nodes, the seat of advanced cheesy degeneration, were high up behind the tonsil, adherent to the internal jugular vein. Adjacent to the vein the nodes were broken down and cheesy; there were a large number of small red nodes stretching toward the clavicle. Histological examination of the nodes showed tubercle bacilli in the cheesy material. The nodes were the seat of tubercular changes.

Child now, six months after operation, is in good health.

In this case it seems an inevitable conclusion that the affection of the tonsil and infection of that organ was the starting point for the involvement of the lymph nodes.

As a portal of infection, there is no reason why the tonsil should not follow the rule and admit of tubercular infection, as it certainly does of pyogenic or diphtheritic infection. The tonsils in children especially are prone to be the seat of repeated inflammatory processes. During this period of life there is a tendency to the hyperproduction of adenoid tissue. Hypertrophy of the tonsils is very common. The tonsil, from its history during childhood, is anything but inactive. On the other hand, very little is known as to the exact method and avenues by which infection of the tonsil occurs. It is customary for one writer to repeat the other in telling us that the so-called leucocytic migration, which, according to Stoehr, is constantly going on in the follicles, is a potent factor in carrying bacteria from the surface of the tonsil to the interior of its crypts.

As to tubercular infection, Cohnheim, Orth, and most writers are agreed that the inspired air plays but an insignificant rôle, if any, and that the infection is brought about through the ingestion of infected food (Fuetterungstuberculose). The tubercle bacilli once implanted on the surface of the tonsil, it is still a matter of speculation how these bacteria work their way into the interior of the organ. It is inconceivable how, with a current of leucocytes directed from the interior of the crypts to the external surface of the tonsil (Stoehr), the bacilli gain entrance, granted that there are normal defects in the surface of the mucous membrane covering the tonsil (Hodenpyle, Stoehr). The theory is that the infectious material is drawn into the tonsil by the acts of swallowing. The question has arisen as to whether hypertrophy of the tonsil predisposes to tubercular infection. It would seem, from

the investigations of Pluder, Fischer, Gottstein, Lartigau, Nicoll, and others, that this was so, though tubercular infection is not as common as we would at first sight suppose, or as some writers would contend. Though some authors have found hypertrophied tonsils, extirpated *in vivo*, to be the seat of tubercular disease in from 5 to 15 per cent. of the cases, Friedmann has examined a large number of these extirpated organs and failed to find tubercular disease, even in the above small percentage of cases. We must conclude, therefore, that, on the whole, tubercular infection of the tonsil of a primary nature is uncommon; as an isolated infection it is exceedingly rare, for in most cases the lymph nodes communicating with the tonsil are drawn into the picture. There is no doubt also that these nodes become infected from the tonsil in the majority of cases—that is, from above downward. Of course, in marked tuberculosis of the bronchial nodes and the lungs the infection of the tonsil may take place against the direction of the lymph current, from below upward. Most writers contend, however, that this mode of infection is rare. Moreover, in the cases published in which this method of infection was supposed to have occurred it would be difficult to exclude the infection of the tonsils by the sputum, and thus of the lymph nodes from the tonsil.

The following case, which occurred in my hospital service, appears to me to illustrate the form of tonsillar infection first described by Orth. This child was admitted to my service with all the symptoms of tubercular meningitis. On admission also it was noticed that the lymph nodes on the left side of the neck at the angle of the jaw were enlarged. The tonsil on the same side could only be made out slightly enlarged, but otherwise with no abnormal appearances. After death of the child the tonsil was extirpated and, as the report shows, was the seat of tubercular changes and contained tubercle bacilli. The enlarged nodes were examined and found to be broken down, cheesy, and the seat of old tubercular changes; there were numerous tubercle bacilli. The lungs, as most of the other organs, were only the seat of acute miliary tuberculosis. The above nodes were evidently the oldest seat of tubercular infection in the body. The bronchial lymph nodes were especially examined, to establish the presence of enlargement or old tuberculosis. A reference to the report of the pathologist shows that only one bronchial node was enlarged to the size of a bean, and was not the seat of tubercular changes. Here we have an evident case of infection through the tonsil of the cervical lymph nodes resulting ultimately in a general acute miliary tuberculosis.

J. S., male child, aged eight years. Diagnosis, tubercular meningitis.

*Family History.* No history of tuberculosis. Patient is the third of six children, first two of whom are dead; cause unknown (both less than one year old). Other three children healthy.

*Previous History.* Born at full term. No rash on body, no conjunctivitis. No history of diseases of childhood until three months ago; at that time child had measles; ill ten days. No cough. After measles complained of pain in neck, and glands below left jaw became swollen (considerably); after a month swelling began to subside. No ear discharge; no sore throat; no cough. Had severe fright about seven weeks ago.

*Present History.* Child commenced to ail again about six weeks ago, having nothing but a little headache and fever from time to time. About ten days ago child felt very weak and complained of severe headache; this again disappeared. Since yesterday child is very stupid, but recognizes its parents and asks for food. No vomiting. Constipated. No convulsions. Slight cough for past two days.

*Status Præsens.* G. C. poor. Fairly well nourished. Tongue moist and coated. Teeth and gums in good condition. Throat negative. Ears and mastoids negative. Pupils equal, dilated, do not react to light. Eyes move independently, causing various forms of strabismus. Very large glands beneath angle of jaw on left side, smaller ones in supraclavicular space, along anterior border of sternocleidomastoid; no glands elsewhere. Apparently hyperæsthetic. Tremor of hands, especially marked on voluntary motion. Rigidity of neck and slight retraction of the head. Kernig moderately marked; no signs of rachitis, but rosary. Babinski present of left foot, marked Macewen. Slight paralysis of left side of face. Hectic flush of cheeks. Tache cerebrale present.

*Lungs—anterior.* Dulness at left apex and in left axilla; harsh increased breathing at left apex and in upper part of left axilla. Numerous subcrepitant râles in right axilla.

*Posterior.* Dulness at left apex, extending to a point half-way between spine and angle of scapula.

*Heart.* Upper border, third rib; right border, right border of sternum; left border, nipple line; apex-beat, diffuse; action, irregular, sounds good, no murmur; pulses, small, rapid, irregular.

*Liver.* Fourth rib dulness; flatness sixth rib to one finger below free border; palpable at free border.

*Spleen.* Tympany over splenic area—spleen just palpable.

*Abdomen.* Lax, tympanitic, somewhat scaphoid, nothing palpable.

*Extremities.* Patellar reflexes present; no œdema. Leucocytes 15,000.

*Lumbar Puncture.* 50 c.c. of clear fluid drawn off. Examination: Microscopic, many small mononuclear leucocytes; spreads, tubercle bacilli found; cultures, negative; albumin, increased one-eighth inch; sugar, negative; specific gravity, 1004.

*March 21st.* Child a little more conscious this morning. Paretic symptoms remain the same.

*23d.* Child lies quietly in bed. No convulsions. Internal strabismus of left eye. Respirations irregular, sighing. Heart action irregular. Increase in size of left submaxillary glands.

The temperature in this case ranged from 101° to 102° F. during the week in which the case was under observation. At the close it rose to 104° F.

*Autopsy.* Performed and reported by Dr. C. P. Bernstein, assistant pathologist Mount Sinai Hospital. Rigor mortis absent. Poorly nourished. Muscles red. No jaundice. No petechiæ. No œdema.

*Thymus.* Not enlarged; extending to level of sternal end of clavicles.

*Tonsils.* Left tonsil considerably enlarged. Right tonsil about normal in size, negative in appearance.

*Larynx.* On lower border of true cords, about one-third distance from their anterior attachment, are two small, distinct tubercles—one on each cord, not opposite. Rest of larynx negative.

*Trachea.* Negative.

*Œsophagus.* Negative.

*Carotid Nodes.* On left side could be distinctly seen and felt. On removal, the upper ones were found to be about the size of a walnut, soft, easily broken down, cheesy (spreads showed numerous tubercle bacilli). From above downward the glands gradually became smaller, lost their soft, cheesy character, until, at the clavicle, they were hard, on section not degenerated, and about the size of a pea. The individual nodes were considerably matted together.

On left side they could neither be seen, felt, nor dissected.

*Lungs.* Pleural cavities contained no fluid. A few fine adhesions at left apex. Parietal pleura negative. Visceral pleura studded with numerous solitary miliary tubercles on both lungs. Lung parenchyma thickly studded with tubercles. Both lower lobes congested.

*Bronchial Nodes.* Hardly enlarged, not congested, anthracotic; no cheesy degeneration.

*Heart.* Pericardium negative. No increase of pericardial fluid. No tubercles. Heart itself showed some paleing of muscle. Mitral valve seat of a recent endocarditis, with fine miliary tubercles on auricular surface of edge. Otherwise flaps negative.

*Aorta.* Negative.

*Coronary Arteries.* Negative.

*Ductus arteriosus and foramen ovale* closed.

*Liver.* Surface and parenchyma studded with miliary tubercles. Organ normal in size; on section, hard and somewhat congested. Slightly fatty in appearance.

*Gall-bladder.* Negative.

*Portal Vein and Ducts.* Negative.

*Spleen.* Slightly adherent to abdominal parietes. Capsule wrinkled; organ normal in size, hard, not congested, pulp not easily stripped off. Miliary tubercles throughout parenchyma and on surface.

*Kidneys.* Normal in size, very flabby; capsule not adherent; markings distinct; slight clouding of cortex; otherwise negative.

*Adrenals.* Negative.

*Ureter and Bladder.* Negative.

*Pancreas.* Negative.

*Intestines.* Beginning at ileocæcal valve and extending almost to pylorus were many scattered tuberculous nodules, varying in size from the head of a pin to a small pea. Many of them were degenerated, allowing the expression of a drop of cheesy pus; some were ulcerated on the surface. Peyer's patches not involved. None extended beyond the submucosa. Mucous membrane throughout gut somewhat injected.

*Colon and Stomach.* Negative.

*Mesenteric Nodes.* Very slightly enlarged; slightly congested; otherwise negative.

*Brain.* Veins of dura and sinus much congested. Considerable fluid in subarachnoid space. Very little œdema at base. Slight adhesions

between dura and caput at vertex. Dura mater and pia mater studded with tubercles. Ventricles (lateral), third and fourth, considerably dilated and filled with clear fluid. Choroid plexus also contained several tubercles, also floor of lateral ventricles. Otherwise, brain negative.

We have seen that the tonsil is the seat of primary tubercular infection, though rarely, as compared to the pyogenic forms of infection. The tubercular tissue is found in the form of giant cells and tubercular nodules; cheesy degeneration in the tonsil is not common; if the tubercle bacilli are abundant, it is exceptional; tubercular tonsillar ulcers are rare; as a rule, the lymph nodes leading from the tonsil are affected. Some of these tonsillar infections have been preceded by a simple catarrhal or diphtheritic inflammation of the organ. Tonsillar tuberculosis may be the source of a general tuberculosis of the body. As far as the cervical lymph nodes are concerned, when found, the seat of isolated tubercular infection, of a primary nature, it can be justly claimed that such infection has proceeded from the tonsil.

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## THE ETIOLOGY OF NASAL POLYPI, WITH ESPECIAL REFERENCE TO THEIR ASSOCIATION WITH OTHER PATHOLOGICAL CONDITIONS.[1]

By Francis R. Packard, M.D.,
of Philadelphia.

On but few subjects in rhinological literature has there been more written than upon nasal polypi, and upon no subject does there seem to exist quite as much confusion in the matter of nomenclature. As

[1] Candidate's Thesis, American Laryngological Association, 1903.

these growths occur with such frequency, and lend themselves so readily to microscopic study, it is greatly to be regretted that more laboratory work has not been done in the effort to clear up their true nature. The real stumbling-block has been due to the fact that so many rhinologists have described them solely from their clinical aspects and without any effort to study their histology.

A brief study of the nomenclature employed in reference to nasal polypi is sufficient to convince us of the confusion or ignorance which exists in the minds of rhinologists as regards these frequently found tumors, and should stimulate us to a more scientific study of their pathological anatomy and of the morbid conditions producing or accompanying them. Jonathan Wright[1] has recently contributed a most interesting résumé of the historical side of the subject, beginning with the views of the ancients and coming down to the most recent time, comprehending not only the work of rhinologists, but also that of the pathologists. It is unnecessary to quote from Dr. Wright's article at length, as it is readily accessible and should be consulted by those interested in its entirety. It is, however, of importance that we should direct attention to his authoritative statement as to the non-myxomatous character of nasal polypi. He regards them as "pendent tissue in the nose which has assumed that shape because of the effusion of serum into it from the bloodvessels;" and after distinctly stating that they are in no way to be regarded as myxomatous tumors, he gives the following able summary of their true pathological histology: "While in the fluid of a polyp there is some mucin derived from glandular structure the polyp may contain, while here and there by careful focussing an occasional embryonal new connective-tissue cell may be seen, there is little or no new formation of tissue, but, on the contrary, a separation of the fibres of the pre-existing subepithelial stroma by serous effusion. In not a few cases these stroma fibres are so scanty, or the effusion of serum is so directly under the epithelium, that the coagulated fibrin threads form the sole framework of the tumor, holding a few leucocytes in their meshes." Goodale[2] has recently expressed the same view, stating that "true myxoma has not been reported from the nose." He regards nasal polypi as "circumscribed hypertrophies," and writes: "The stroma of these growths consists of more or less connective tissue, the meshes of which contain round cells and albuminous fluid. They are covered by a cylindrical epithelium which in places, exposed to external irritation, tends to become altered into pavement epithelium. The glands of the growth may be increased in number, having in the majority of cases the character of mucous glands. At times there occur in them so-called serous glands. The

[1] Trans. Amer. Laryng., Rhin., and Otol. Soc., 1901.

[2] A Treatise on Diseases of the Eye, Nose, Throat, and Ear, edited by Posey and Wright, 1902.

acini of the glands often show cystic dilatation, which may at times be so marked as to form a cyst occupying the greater portion of the growth." E. Fletcher Ingalls[1] likewise writes as follows: "Nasal mucous polypi are not myxomata, but outgrowths from the connective tissue of the nasal mucous surface, and hence are to be considered fibromata," representing "a hyperplasia in a state of œdema."

At the meeting of the American Laryngological Association in 1899 there was a symposium on the relation of pathological conditions of the ethmoid region of the nose to asthma. Dr. Henry L. Swain discussed the matter from a pathological standpoint. He stated that in his view nasal polypi were simply œdematous hypertrophies, and traced their etiology to hypertrophies of the turbinal tissue, which as a result of repeated attacks of congestion had become stretched and flabby, and as a result of their dependent position infiltrated with clear serum. Drs. Clarence C. Rice and E. Fletcher Ingalls wrote on the clinical phases of the relation of the ethmoid disease to asthma, pointing out the frequency with which they were found together. Dr. F. H. Bosworth, in the closing paper of the symposium, in writing on the subject, stated that he believed "polypoid degeneration of the mucous membrane of the nose, œdematous hypertrophy of the mucous membrane of the nose, and nasal polypi all indicate and are clear symptoms of ethmoiditis," and he strongly urged rhinologists to bear in mind the fact that polypi were symptoms of an underlying ethmoiditis. The discussion of the four papers elicited the usual variety of views as regards the etiology and pathology of intranasal polypi.

The fact that they are not true myxomatous tumors is asserted by Kyle,[2] who, while dealing with polypi under the heading "Nasal Myxoma," states that they are the result of myxomatous degeneration of the mucous membrane and are in no sense new-growths. Bosworth,[3] on the other hand, entitles chapter XVIII. of his book "Nasal Polypus or Myxoma," and writes: "The prevailing type of these tumors is that of pure myxoma, with certain more or less well-marked variations, attendant probably either on their immediate origin or perhaps on certain adventitious features of their subsequent development, surroundings, or life." Bosworth's classification is that which was used by J. Solis Cohen and Morell Mackenzie in their treatises, and is probably that which is most commonly adopted by the authors of articles on polypi in the current periodical literature.

In foreign rhinological literature the same confusion of terms exists. Zuckerkandl[4] was inclined to regard polypi as adenomata, although, as

[1] Diseases of the Nose, Throat, and Ear, by Burnett, Ingalls, and Newcomb, 1901.
[2] Text-book of Diseases of the Nose and Throat, 1901.
[3] Treatise on Diseases of the Nose and Throat, 1893, vol. i. p. 387.
[4] Normale und Pathologische Anatomie der Nasenhohle.

Bosworth points out, his classification included within its limits some formations which can hardly be properly considered as true polypi, such as hypertrophy of the mucous membrane covering the posterior extremities of the lower turbinates and papillomatous growths.

Probably no one man has done more to clear up the true nature of nasal polypi than Hopmann.[1] He states that they are œdematous fibromata, basing this largely on their microscopic structure and on the fact that they react to heat in the same manner as egg-albumen, whereas mucin did not. Of late there has appeared a tendency among many rhinologists to revert somewhat in the direction indicated by Woakes,[2] and attribute the existence of polypi to disease of the periosteum and osseous structure of the ethmoid cells. Thus Lambert Lack[3] holds that a polypus is "a simple localized patch of œdematous mucous membrane, and that this œdema is a result of disease of the underlying bone." He has examined pieces of bone removed with polypi from over thirty cases, and in every instance has found a rarefying osteitis which commences with a proliferation of cells in the deeper layer of the periosteum. Accordingly he substantially agrees with Woakes in his theory of the origin of polypi as a result of bone disease, as did many other participants in the discussion in which he made this statement.

Grünwald[4] believes that "polypi in the majority of cases are almost as good as pathognomonic of empyemata of the accessory cavities or focal suppuration in the nasal passages." He sums up the results of his examination of eighty-two persons in whom polypi were observed—seventy-one of whom were certainly the subjects of focal suppuration. Grünwald states that "when Woakes maintains that he has never seen a case of nasal polypus in which he could not find necrosis he is contradicted by my experience as detailed above, but only in part. It is decidedly a one-sided view to refer all polypi to ethmoidal disease, seeing that other empyemata and focal suppuration are just as potent in causing them; in the same way Woakes' statement that he has never

[1] Hopmann's articles on the subject begin with a paper which he published in Virchow's Archiv in 1883, No. 93, and were followed by a number of contributions appearing subsequently, as follows: Monatsschrift f. Ohrenheilk., June, 1885, the Archiv f. Ohrenheilk., 1887, No. 5, vol. xxi. p. 124, wherein he announced his intention of publishing a series of articles substantiating his contention that polypi were œdematous fibromata and not myxomatous growths. These articles were entitled "Was ist man verechtigt Nasenpolyp zu nennen?" Beginning in vol. xxi., No. 6, p. 152, they continue through three subsequent numbers. He was incited to write these articles by the statement made by Kiesselbach in Monatsschrift f. Ohrenheilk., 1887, No. 4, vol. xxi. p. 89. Kiesselbach wrote a reply which was published in the Monatsschrift f. Ohrenheilk., 1888, No. 12, vol. xxii. This whole series of articles will well repay perusal.

[2] Lancet, 1885, No. 11, p. 108; Nasal Polypus with Neuralgia, Hay Fever, and Asthma in Relation to Ethmoiditis, London, 1887.

[3] Journ. Laryng., Rhin., and Otol., February, 1901.

[4] Treatise on Nasal Suppuration, New York, 1900.

seen a normal middle turbinal can only be characterized as an incomprehensible exaggeration."

John N. MacKenzie[1] has made a thorough study of the pathological anatomy of ethmoid disease, based on careful microscopic investigation of the tissues removed from a case under his observation. Among his conclusions we find: that nasal polypi are not myxoma, nor are they the result of a myxomatous degeneration; that purulent ethmoiditis may continue for years without any involvement of the bone; that in the ethmoid and middle turbinated regions the ordinary nasal polypus is developed as follows: "The first stage consists in the formation of young granulation tissue, the result of inflammatory action. In the second stage this tissue becomes gradually converted into definite adult connective tissue, which in the third stage gradually separates and causes more or less complete obliteration of the normal structures, and in the fourth stage converts them into a fibrous mass." He says he cannot go as far as Grünwald in attributing polypi to suppuration. They are in the vast majority of cases due to inflammation. The presence of suppuration he regards as an incidental phenomenon, and as of secondary importance.

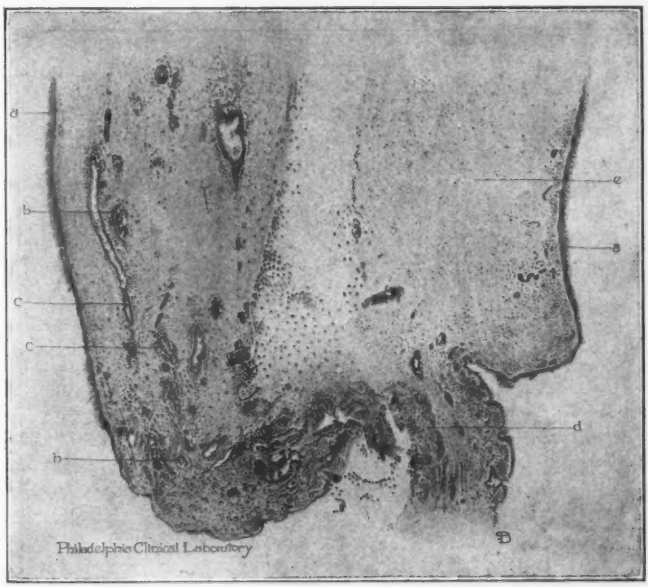
When we take into consideration the ample opportunity afforded for the study of intranasal polypi, one may well wonder at the diversity of the views expressed concerning their nature, and yet a thorough understanding of these growths is of the utmost importance to their proper treatment. Bosworth, in repeating Zuckerkandl's often-quoted statement that he had found polypi or polypoid degeneration in one out of every eight or nine autopsies, adds that in his own experience of 1418 cases of ordinary catarrhal disease seen in private practice 134 showed the presence of fully developed polypi, or about one case of polypus for every eleven cases of ordinary catarrhal trouble. Other statements might be adduced to strengthen the proof of their frequent occurrence, but it is a matter of almost daily experience with rhinologists, and can, therefore, be passed by with the statement that their frequency should have led to a more complete knowledge of their pathological histology.

Another matter of common experience is the frequency with which they recur after apparently complete extirpation. This feature should certainly teach us the necessity of ascertaining the real cause of their presence in every case, and if possible removing it. This point I consider of particular importance, as I believe recurrence is especially frequent when polypi are the result of caries or necrosis of the ethmoid bone, and that they can only be finally extirpated by the removal of the diseased bony tissue. A most apt confirmation of this view has occurred to me in the last six cases of intranasal polypi which have

[1] Journ. Laryng., Rhin., and Otol., February, 1897.

come under my care in my private practice. Of these four presented a history of previous removal of polypi. In each of them both nostrils were more or less completely blocked by polypi, and after the removal of one or more of the growths rough bone could be detected with a probe in the region of the middle turbinate. The polypi were all removed, and with them a large part or the whole of the middle turbinate, and in every instance, although some months have elapsed, there has been no recurrence. In the two remaining cases there was no history of the previous removal of polypi, but in both of them there

FIG. 1.



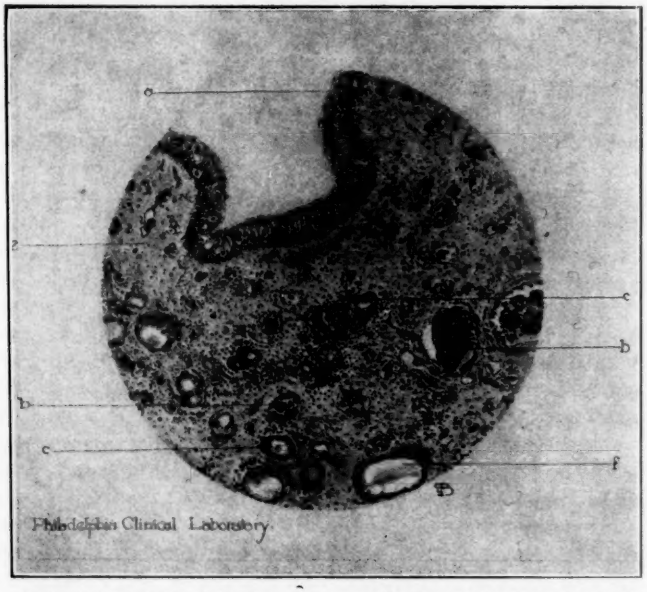

Nasal polyp drawn from author's specimen: *a*, epithelium; *b*, bloodvessel; *c*, gland; *d*, fibrous connective tissue; *e*, mucoid matrix.

was a suppurating ethmoiditis, and after removing one or two polypi I was able to remove dead bone from the middle turbinate region. There has been no evidence of trouble since. I am convinced that in all six cases the polypi were present as a result of the disease of the bone; that the recurrence in four was due to failure to recognize their etiology and remove the cause, and that they would have recurred again in all six cases had I not found the necrosed bone and removed it.

I have of late been making it a routine practice to have sections cut of every polypus which I remove from the nose. The accompanying two cases I submit as very typical in their clinical history and microscopic characteristics of the conditions under which nasal polypi generally present themselves.

CASE I.—A man, white, aged forty years, who has always considered himself particularly strong and healthy, and could not recall ever having had any serious illness. Eight years ago fourteen polypi were removed from his nasal chambers. He says that at that time both nostrils were completely blocked, and that the removal of the growths seemed to give him absolute relief. For the last two or three years

FIG. 2.

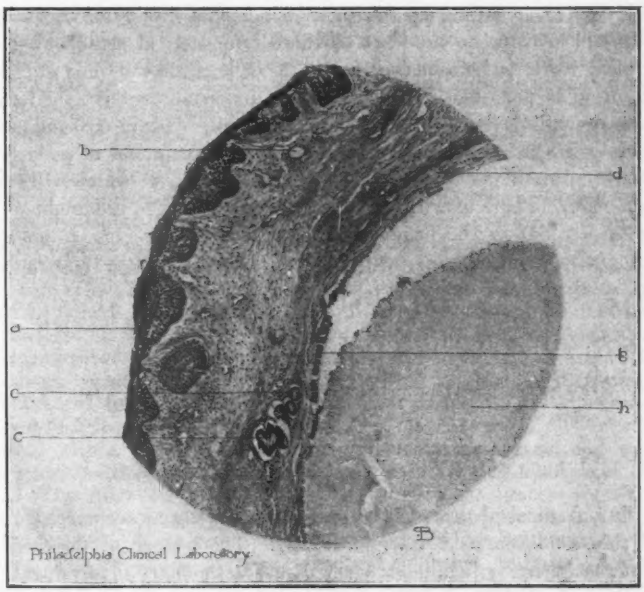



Nasal polyp drawn from author's specimen: *a*, epithelium; *b*, bloodvessel; *c*, gland; *e*, mucoid matrix; *f*, beginning mucoid degeneration of gland.

he has noticed increased obstruction to nasal respiration. On examination polypi could be seen almost protruding from each nostril anteriorly. Under cocaine, with the cold-wire snare, I succeeded in removing in all eleven polypi from the left and four from the right nostril. Dead bone was felt with a probe in both nostrils in the middle turbinate region. The patient objected, however, strongly to further operative procedures for its removal. He is still under my care, and has lately told me that he would submit to the removal of dead bone owing to my repeated statements to him that I was sure the polypi would recur again unless thorough erasion of the bone was made.

Fig. 1 shows a section (under low power) of one of the polypi removed from his nose. The fresh tissues were fixed in Orth's fluid and embedded in celloidin. The section was from three to five microns in thickness, and was stained in Ehrlich's acid hæmatoxylin, with an eosin counter-stain. Its gross appearance was typical of the ordinary nasal mucous polypus; as the section shows, it was covered with normal epithelium, and consisted of a mucoid matrix, with some fibrous connective tissue, and quite a few glands. Fig. 2 shows a field drawn from the same section under high power. The most interesting feature shown by it is the gland *f*, which was beginning to undergo a mucoid degeneration.

Fig. 3.




Nasal polyp from author's specimen: *a*, flat-celled epithelium; *b*, bloodvessel; *c*, gland; *d*, connective tissue: *g*, degenerated gland epithelium; *h*, mucoid degeneration with calcareous infiltration.

Case II.—A girl, aged eighteen years, was referred to me complaining of tinnitus and considerable deafness in the right ear; the condition had lasted for six months. She had had chronic suppurative otitis media in the same ear when a child. Examination revealed a very much retracted, fibrous, and scarred right membrana tympani. The right nostril was almost completely filled both anteriorly and posteriorly with a mass of polypi. These were gradually removed at repeated sittings by the cold-wire snare; I also removed a large mass of necrosed bony tissue from the region of the middle turbinate. This patient has now normal hearing, and has no tinnitus in her right ear. Fig. 3 is a

section of a polypus removed from her nose. It was fixed in alcohol, then decalcified in nitric acid, embedded in celloidin, and stained in Ehrlich's acid hæmatoxylin, with an eosin counterstain.

Clinically it was most deceptive. When the wire came in contact with the calcareous material with which it was infiltrated I supposed that it was bony in character, as I had already removed dead bone from the same nostril.

In the numerous sections which I have cut there has been absolutely no evidence of anything in the nature of a true myxomatous tumor; on the other hand, mucoid degeneration was commonly found. In both these very typical cases which I have detailed the growth was associated with the presence of dead bone.

My object in presenting this present incomplete study of the subject is to add my mite to the work of those interested in establishing our clinical work on a scientific basis. I believe that if only sufficient attention is persistently directed to this important subject the heretofore prevailing laxity in nomenclature will disappear; and when rhinologists have learned that nasal polypi are symptoms of underlying conditions, and not "tumors," the mere removal of which will result in a complete cure, it will redound greatly not only to the credit of the profession, but to the benefit of the patient, by lessening, if not altogether abolishing, the frequent recurrence of polypi after their removal by operation.

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## HYPERTROPHIC TUBERCULOSIS OF THE LARYNX.

By Clement F. Theisen, M.D.,
of Albany, N. Y.,
Lecturer on Diseases of the Nose and Throat, Albany Medical College.

The classical picture of laryngeal tuberculosis makes the recognition of this condition, as a rule, quite easy. The history of the case, the fact that there is in almost every case a pulmonary involvement, the finding of tubercle bacilli in the sputum or in scrapings from the larynx, the well-marked constitutional symptoms, and the steady advance of the pulmonary symptoms are factors which always clear up the diagnosis. Add to this the typical changes in the larynx, the infiltration, aphonia, and characteristic ulceration, and we have a symptom-complex which is practically peculiar to laryngeal tuberculosis only. The character of the *ulceration* particularly is the symptom in the clinical presentation which is peculiar to the type of tuberculosis of the larynx usually observed.

Hypertrophic or, as it may perhaps properly be called, hyperplastic tuberculosis of the larynx, which will be the only form of the disease considered in this paper, presents an altogether different clinical picture.

The following case observed by the writer is a good illustration of this very unusual type of laryngeal tuberculosis. This case is of particular interest because of the great diversity of opinion in regard to the patient's condition. He was seen by a number of laryngologists in different parts of the country and different diagnoses were made.

Mr. M. I., aged forty years, native of Germany, merchant, married, two children, consulted the writer February 19, 1901, for hoarseness that had existed for a year. His family history was negative, there having been no cases of tuberculosis so far as he knew. He had always been subject to colds. Syphilis was denied. His physical condition at the time was excellent, weight about 175 pounds, and he had only lost about five pounds during the past six months. He was very hoarse, the voice being decidedly weak; in fact, the aphonia was nearly complete. His appetite was excellent, and he had no night-sweats. He coughed very little at this time, and several careful examinations of the lungs gave absolutely negative results.

We did not discover tubercle bacilli in the sputum, but Dr. Roarke, of Troy, who had also examined his larynx and made a diagnosis of tuberculosis, told me that a few had been found in a former examination. His nose, nasopharynx, and pharynx, with the exception of a chronic follicular pharyngitis, did not show any particular changes. His larynx, however, presented the following interesting condition: The mucosa was generally somewhat reddened, with a well-marked thickening in the interarytenoid space, which was firm to the touch. Both arytenoids were thickened and infiltrated, this being more marked in the left than the right. Both cords were thickened, and there was a circumscribed thickening of considerable size on the left cord near the processus vocalis. There were circumscribed hypertrophied areas on both ventricular bands, with broad bases, not presenting the appearance of new-growths, but rather of hyperplasia of the tissues. They were covered with a perfectly intact, smooth mucous membrane, and were of a grayish-red color. This was one of the interesting features of the case. The epiglottis was not involved, nor did the process appear to extend below the cords. There was absolutely no ulceration anywhere in the larynx. A diagnosis of laryngeal tuberculosis was made by the writer, in spite of the atypical laryngeal condition, and the negative examination of the lungs. The patient was told that he had a good chance for recovery in Denver. This favorable prognosis was given because his lungs at this time did not show any evidence of tuberculosis on physical examination. He started for Denver, but on the way consulted a well-known laryngologist of the West, who gave it as his opinion that the case was *not* tuberculous. I believe he was given potassium iodide for some time, with local treatment, but did not improve. (I would like to state at this time that this paper is not written in a spirit of criticism. The physician who examined him in the West did not know that tubercle bacilli had been found in the sputum. Nobody not knowing this could have made a positive diagnosis. Because, however, this case has already been published elsewhere as one of pachydermia laryngis, and on account of the different diagnoses that have been made, but particularly because the outcome of the case justified the diagnosis of tuberculosis, a thorough and impartial presen-

tation of its clinical history was considered important.) The patient then returned to New York, where he was under the care of a laryngologist, and was seen by a number of others, one or two of whom agreed with the writer's diagnosis. The physician who treated him in New York reported the case as one of pachydermia laryngis (*New York Medicinische Monatsschrift*, November, 1901, p. 528). In this article he states that a laryngeal ulcer was discovered in Albany. This is an erroneous statement, because at no time while the patient was under the observation of either Dr. Roarke or the writer was there any evidence at all of ulceration. Repeated examinations of the sputum in New York failed to show the presence of tubercle bacilli. This fact was stated in a letter to the author by the patient's physician there, and the statement was also made "that as there were no signs over the chest, the case, if not pachydermia, could only have been primary tuberculosis of the larynx." The patient grew steadily worse, and was finally sent to Saranac Lake in June, 1901, where he was under the care of Drs. Trudeau and Baldwin. He died there August 4th, with well-marked laryngeal and pulmonary tuberculosis.

In answer to inquiries in regard to the patient's condition at Saranac, letters were received from Drs. Trudeau and Baldwin, from which I will give abstracts. (Dr. Trudeau's letter was in answer to an inquiry whether in his experience tuberculosis of the larynx often developed after pachydermia.) "I often find," he wrote, "that pachydermia laryngis coexists with tuberculous laryngitis, but I don't think I have ever had much reason to believe that the warty growths were anything more than a *complication* of the original tuberculous process." Dr. Baldwin sent me the following record of the patient's condition when seen by him June 10, 1901: "Advanced pulmonary and laryngeal tuberculosis, dulness on right apex, with prolonged expiration, moist râles to fourth rib." I also quote the following from his letter: "The patient came to me with fully developed pulmonary and laryngeal tuberculosis on June 10th, and died August 4th. Your letter indicates that he had more signs on left side of the larynx; by June, however, the right arytenoid and cord were more infiltrated, and there was some ulceration of the cords. He died without ulceration of the arytenoids or epiglottis." The writer has been careful *not* to call this even a *probable* case of primary tuberculosis of the larynx, although in other parts of the body this hypertrophic form of the disease sometimes precedes the lung involvement. In the larynx, however, primary tuberculosis is excessively rare, and I have always been of the opinion that it did not occur, because post-mortem findings have demonstrated the fact over and over again that tuberculous processes in the lungs *had* existed in cases of laryngeal tuberculosis, even though they were not discovered during life in the most careful physical examination. One of the only positive cases of primary laryngeal tuberculosis that I have been able to find in the literature is the case reported by Fraenkel (see

Duesberg's article[20]). In this case the patient had been treated for five years for laryngeal tuberculosis. At the autopsy neither in the lungs nor in any other organ, except the larynx, was there any evidence of tuberculosis. This is one of the few cases on record in which the diagnosis was proved post-mortem. Cohen has reported three cases that were also probably primary. A résumé of the clinical history of this case brings out some interesting points, *i. e.*, a tuberculous condition of the larynx that existed for a year and a half before any ulceration developed; the normal physical examination of the lungs up to the time the patient went to Saranac, the well-marked circumscribed hypertrophies of the ventricular bands, the decided thickened areas on the vocal cords, and the swelling of the arytenoids. This was of the nature of a thickening of the tissues, and not the œdema usually found. Taking all these facts into consideration, I believe a diagnosis of hypertrophic tuberculosis was justified.

Diagnosis. In considering the diagnosis of this unusual form of laryngeal phthisis, we must first dispose of the differential diagnosis of the writer's case from pachydermia, particularly as it was published as a case of pachydermia. The fact that a thickening of the vocal cords existed near the processus vocalis, a common seat for pachydermic masses, was *not* an argument for pachydermia in this case, because there was not only not the usual depression on the surface of the nodule, which is caused by the pressure of a nodule directly opposite on the other cord during phonation ("pachydermische dellen"), and which is characteristic of pachydermia, but, in fact, a node on the other cord opposite the one on the left cord did *not* exist. We have abundant authority in the literature of the subject for this characteristic appearance of the pachydermic node. Fraenkel,[24] Virchow, Symonds,[26] and others have described it as characteristic. Pathologically, pachydermia cannot be considered a condition *sui generis*, but merely a result of the chronic laryngitis of alcoholics, inveterate smokers, or a part of the clinical picture of tuberculosis or syphilis. I believe alcohol and tobacco are the two most important factors in producing pachydermia. (The writer's patient was a man of excellent habits.) Great stress is laid upon this by Sturmann.[25] Really only the diffuse form of pachydermia need be considered in the writer's case. In this form the products of the hypertrophy of the epithelium very often break down rather easily, forming cracks or superficial ulcers on the surface of the pachydermic nodes. Habermann[27] mentions the frequency with which this ulceration occurs in pachydermia. He found it twenty-one times in fifteen larynges. Moll[23] considers pachydermia simply a form of chronic catarrhal laryngitis. Zwillinger[28] thinks it is akin to leukokeratosis, and claims that the two conditions have the same etiology, and are identical clinically and anatomically. To conclude the differential

diagnosis of pachydermia and hypertrophic tuberculosis, then, we may *exclude* pachydermia when the characteristic circumscribed hyperplasia of the ventricular bands or other parts of the larynx is present, when we do not get a history of excessive drinking and smoking, when syphilis can be excluded, when the depression on the pachydermic node is absent (this was always present in cases observed by the writer), and when all other factors that would cause a chronic laryngitis can be excluded. In the writer's case the condition certainly simulated a diffuse pachydermia, but, as later developments proved, it was *not* pachydermia but *tuberculosis* all the time. It is much more difficult to make a diagnosis in a case in which carcinoma develops from or coexists with an apparent condition of pachydermia. Fraenkel,[29] in his able article, thoroughly discusses this point, and in conclusion states "that carcinoma develops not infrequently from pachydermia." He reports cases to prove this statement. General or circumscribed hyperplasia of certain parts of the larynx is characteristic of the form of tuberculosis under discussion, and this hyperplasia of the tissues occurs in other parts of the body, as well as a manifestation of hyperplastic tuberculosis. Lartigau,[34] in his article "Hyperplastic Tuberculosis of the Intestine," etc., mentions this as the fundamental lesion. Some of the most interesting and characteristic features of the intestinal form are the polypoid and papillomatous formations mentioned by Pilliet (Lartigau). These tumor-like formations are not very uncommon in the larynx, and a number of the recorded cases unquestionably belong to this type of laryngeal phthisis. In order to get a thorough idea of the diagnosis of this interesting form of laryngeal tuberculosis, it will be necessary to briefly review the cases in the literature. There are only a few on record with the title "Hyperplastic Tuberculosis," although I have been able to find a number of others that belong in this classification. If, for example, we give the term hypertrophic or hyperplastic tuberculosis its widest meaning, we must include certain forms of tuberculous tumor formations, in which the tumors are covered with intact mucous surfaces (although some ulceration may be present in some other part of the larynx), and in which the tumor developed *before* the ulceration. I do not think that tuberculous granulomata, for example, which develop at the site of an ulcer and which break down easily, belong in this class. I quite agree with Schech's[31] statement that "tumors should only be called tuberculous in which earlier ulceration at the site of the tumor can be excluded."

The following classification of hypertrophic tuberculosis of the larynx is suggested by the writer as a convenient one. No arbitrary classification can be made. It is, of course, understood that no case will be included in which a positive diagnosis was not made. The following cases, although not entirely complete, are practically all that I could

find in a thorough search of the literature in which the diagnosis of tuberculosis was proved:

Class I. Cases in which the characteristic changes in the larynx consist of either a marked hypertrophy or hyperplasia of the tissues, or in which tumor-like formations *without* ulceration occur.

Class II. Distinct tumors, usually covered with intact mucous surfaces, and called by the French the "type d'Avellis," which seem frequently to originate in the ventriculus Morgagni. These tumors may or may not be pedunculated.

Class I. The following rare cases, of which I will give brief abstracts, belong in this class:

John N. Mackenzie[1] reports two cases observed by him in the Rudolph Hospital, Vienna. The specimens, which were removed at autopsies by Dr. Hans Chiari, were examined by Mackenzie microscopically: 1. Tuberculous tumor of the trachea. Pharynx, larynx, and trachea free from ulceration. A circumscribed tumor was found in the trachea, about 1½ cm. above the bifurcation, and was about the size of a bean. A similar one was found in the pericardium. Microscopically the tumors consisted of tuberculous nodules set in a network of hypertrophied connective tissue. 2. Tuberculous growths of the vestibulum laryngis. Patient died of pulmonary tuberculosis. The epiglottis, aryepiglottic folds, and ventricular bands presented a remarkable granular appearance, due to the presence of small, smooth, dense, nodular growths. No trace of ulceration in the pharynx, larynx, or trachea. Microscopic examination disclosed the same appearances as in Case 1. He also describes tuberculosis of the laryngeal muscles, and reports a case in which large well-marked tubercles were found embedded in the muscular tissue and absolutely unconnected with the tuberculous infiltration of that part of the larynx. This case is extremely rare and bears out Heinze's similar investigations.

Foa's[2] case. Foa reports a rare case of this form of tuberculosis. I will give only the post-mortem findings. There was well-marked evidence of pulmonary tuberculosis as well as of the ileum and mesenteric lymph glands. In the larynx, at the base of the epiglottis, on its inferior surface, in the region of the arytenoids, and on the cords, there were numerous eminences, from 2 to 4 mm. long and 2 to 3 mm. wide. Absolutely no ulceration of the laryngeal mucosa. On microscopic examination the vegetations were made up mainly of connective tissue, and contained some giant cells and epithelioid cells. An inflammatory condition of the mucosa, with a well-marked hyperplasia, could be made out. Tubercle bacilli were found in portions of the tissue removed.

Lermoyez's[3] case. A man, aged forty years, entered the Hospital Bichat in Gougenheim's service. Had had severe hæmoptysis. There

was difficulty in breathing, marked aphonia, and inspiratory dyspnœa. A large mass was seen in the larynx in the region of the cords. It was difficult to determine the exact point of origin. During inspiration the growth descended below the glottis. A tracheotomy was performed, and a large subglottic growth similar to a polypus was found. Patient died five days after the operation. At the autopsy a large mass, attached in the angle of insertion of the right cord, was found. This is rare in the history of tuberculous vegetations. There was tumefaction of the left cord and beginning vegetations.

Ariza[4] has contributed several articles on this subject. In the first he simply and very incompletely reviews the literature, and describes the vegetative or hypertrophic form of laryngeal tuberculosis. There are sometimes enormous localized hypertrophies of the tissues. He also refers to the fact that there may be no ulceration in these cases. In the second article he mentions the great difficulty in making a diagnosis, and that the hypertrophy is seen chiefly in the ventricular bands and cords, and may be so extensive as to make tracheotomy imperative.

Doleris'[5] case. The patient, aged sixty-three years, had severe hæmoptysis and dyspnœa at night. Complete aphonia had existed six months. Death occurred suddenly, with symptoms of asphyxia. At the autopsy the following interesting changes were found in the larynx: There was marked hypertrophy of the entire mucous membrane, the thickening being so great that the lumen of the larynx was reduced to one-quarter the normal size; the cords were effaced. The epiglottis and aryepiglottic folds were thickened and there was some subglottic hypertrophy. Mucous membrane was very pale. There was slight ulceration in the region of the right ventricular band. Pulmonary tuberculosis was also found. There was marked sclerosis of areas of lung tissue and a formation of fibrous tissue. A cavity existed in the right lung as large as a small orange.

This is, perhaps, the most marked example of hypertrophic tuberculosis of the larynx on record.

Schnitzler's[6] case. The patient, a young man, came to Schnitzler's clinic for the relief of urgent dyspnœa. Laryngeal examination showed the presence of several grayish-white tumors varying in size from a bean to a hazel-nut, not ulcerated, situated mainly in the ventricles of Morgagni, and almost completely filling the upper part of the larynx. Schnitzler makes the statement in this article that, laryngoscopically, these tuberculous tumors had probably never before been observed, and later, in another article (*Wiener med. Presse*, November 16, 1884), he questions Dr. John N. Mackenzie's right of priority in describing such tuberculous tumors. Mackenzie's cases were certainly published before Schnitzler described the above case. It was seen by Schnitzler (see Crepon's article) in 1882, but it was not reported until

1884. Tracheotomy was performed by Billroth in Schnitzler's case, and then by an endolaryngeal operation the tumors were removed. Microscopic examination proved the diagnosis.

Dehio's[7] case. Tumor of the larynx; no ulceration. Tumor attached to left ventricular band by a broad base, covering the whole band. Great thickening of the right ventricular band. On microscopic examination no evidence was found of caseation of the tubercles. There were bacilli in the tissue removed for examination.

Henning's[8] case. Man, aged fifty-two years; good family history. In the region of the left cord there was a round, smooth tumor, with a broad base, and covered with normal mucous membrane. The tumor covered the posterior two-thirds of the left cord, left ventricular band, and ventriculus Morgagni; probably originated in the ventricle. Laryngotracheotomy was performed. Diagnosis was proved by the microscopic examination.

Koch's[9] case. Tuberculous tumor of the larynx removed by laryngotracheotomy. Diagnosis verified by microscopic examination.

Hopmann's[10] cases. (Reported by Karl Becker.) 1. Tuberculous tumor of the anterior commissure; laryngotomy. 2. Tumors of the ventricular bands and cords; laryngotomy; death in two months from pulmonary tuberculosis. 3. Tumor of the anterior part of the right cord. Two operations were performed, and eleven years after the patient, who was a minister, had suffered no recurrence and could use his voice both for speaking and singing. (Remarkable case.) 4. Tumor nodules of the anterior part of the cords and the epiglottis. 5. Large tumor of the anterior commissure; pulmonary tuberculosis; operation followed by cure.

Küster's[11] case. Woman, aged forty-six years; prominent tumor in the anterior commissure. There was very slight ulceration in the larynx; a laryngotracheotomy was performed.

Josephsohn's[12] case. Reported as a case of primary tuberculosis, but as there was no autopsy it cannot be so called. Girl, aged twelve years, with marked tumefaction of the epiglottis and hard infiltration, with tumefaction of the arytenoids. Symptoms on the part of the lungs did not appear until shortly before death. There was slight ulceration on the posterior wall of the larynx.

Kidd's case is not included in this classification because there was some doubt about the diagnosis.

Castex[13] has called attention to certain nodules occurring on the cords, to which he has given the name nodular tuberculosis. They frequently become tuberculous and are grayish-red in color.

Class II. While this class of pedunculated tumors can, perhaps, not be called typical examples of hypertrophic tuberculosis, they must be considered a form of the disease. Lartigau includes papillomatous

excrescences and polypoid formations as a type of hyperplastic tuberculosis of the intestine.

Billroth's[14] case. Two pedunculated papillary excrescences of the left cord, with a subglottic tumor. A diagnosis of epithelioma was made, but after the growths were removed tumors were found to be tuberculous; no ulceration in the larynx.

Panzer's[15] cases. (Reports three cases.) Two apparently ordinary polypi of the cords were found, on histological examination, to be tuberculous. In the third case there were papillary excrescences on the left vocal cord. In two of the cases the tumors occurred in otherwise perfectly healthy larynges.

Clark's[16] case. Woman, aged twenty-one years; no evidence of pulmonary tuberculosis. Had been hoarse for three years. Pedunculated tumor in the larynx attached to the left ventricular band. Diagnosis proved after removal of growth. No recurrence after a year and a half.

Kirkpatrick's[17] case. Papillomatous mass in the interarytenoid fold. Diagnosis proved microscopically.

Bronner's[18] case. Pedunculated new-growth attached to the left cord in a tuberculous subject. Found to be tuberculous on microscopic examination.

Sachs'[19] cases. Two cases of laryngeal tumors with normal lungs. (He considered them primary, but I could find no record of autopsies.)

One of the most important works on the subject of tuberculous tumors has been written by Avellis.[20] He has reported thirteen cases observed by himself. There are cases belonging to both classes. The tumors in his cases were circumscribed, and there was no laryngeal ulceration. He states that this form is probably sometimes primary. In this connection a series of cases studied by Moser[21] is of interest. He describes cases in which practically the only evidence of laryngeal tuberculosis was the thickened and nodular epiglottis. As a rule, there was either no ulceration or very little in the larynx. Sometimes this same thickening was noticed in the larynx. Some of these cases are undoubtedly examples of hyperplastic tuberculosis. A case of lupus of the epiglottis has recently been reported by Chambers (*Laryngoscope*, February, 1903), which simulates somewhat Moser's cases. It is of interest in this connection, because a section was sent to Dr. A. O. J. Kelly, of Philadelphia, who reported that the case *was* one of hyperplastic tuberculosis. Jonathan Wright was more inclined to the opinion that it was lupus. Gougenheim and Tessier,[22] in their admirable work, were the first to describe cases occurring in children, as "pseudopolypoid scleropapillary" forms. "La texture est toujours lamieme; ce sont les hypertrophies papillares, developpées sur la muqueuse tuberculeuse à l'occasion action irritative ou inflammatoire." These cases they claim

may sometimes be primary. As before stated, however, I believe that primary cases of this or any other form of laryngeal tuberculosis occur with extreme rarity. Fraenkel's case is one of the only ones I could find in which the diagnosis was verified by autopsy. It is possible that Hopmann's third case, in which there was no recurrence for over eleven years after the removal of a tuberculous growth, was primary. It is more than likely, if the lungs had been involved in this case, that the patient could not have lived so long without a recurrence. Dehio's case may also have been primary. There were, however, no autopsies in these two cases.

A study of the cases described in this paper would appear to the writer sufficient to clear up the diagnosis of the different forms of hyperplastic tuberculosis. A histological examination will usually settle all doubt, although there are cases in which the histological structure simulates sarcoma. Attention has been called by Koschier to the occurrence of rhinoscleroma associated with tuberculous infiltration of the pharynx and of both arytenoids. In connection with the diagnosis of the writer's case, this condition need hardly be considered. In the first place, rhinoscleroma is excessively rare in this country, and, secondly, primary scleroma of the larynx is very rare. In almost every case the characteristic lesions in the nose will be found. Schrötter[35] has also called attention to the occurrence together of scleroma and tuberculosis. Hypertrophic tuberculosis must also be differentiated from lupus, syphilis, sarcoma, and carcinoma. Lupus, as stated by Emil Mayer, *is* tuberculosis, but occurs in another form. It differs from the form of tuberculosis under discussion in that in the larynx it usually involves the epiglottis. Primary laryngeal lupus is, too, extremely rare, although it has been mentioned by Mayer (*New York Medical Journal*, 1898). Macroscopically, lupus tissue has rather a different appearance. There are usually pale, elevated nodules, which sometimes ulcerate at their apices. These ulcers heal very slowly, and as one cicatrix forms another nodule may break down, giving a characteristic appearance which differs essentially from that of hyperplastic tuberculosis. A histological examination of lupus tissue is not always of much help, and the diagnosis must often be made by exclusion. The fact that the lingual surface of the epiglottis is usually affected first and the very slow course of the disease will assist in clearing up the diagnosis. Then, of course, in the vast majority of the cases lupus is a secondary process. True syphilitic tumors (syphilomata), when they occur in the larynx, present many more diagnostic difficulties. There is a form of syphilitic tumor which I have observed several times, which, like the tuberculous tumor, may or not be pedunculated, is covered with an intact mucous membrane, and may not break down for a long time. Such cases are extremely difficult to

differentiate clinically from hyperplastic tuberculosis. A history of syphilis can, however, usually be obtained, and, even if not, the administration of potassium iodide will settle all doubt. Syphilitic hyperplasia, which is made up simply of granulation tissue, quickly breaks down, forming the typical ulceration. This is true also of the syphilitic granuloma, which is simply an inflammatory condition that develops around an ulcerated surface, and of the gumma. From beginning carcinoma and sarcoma the hyperplastic form of tuberculosis can be differentiated by the histological examination. The further course of the disease and the typical laryngeal appearance in advanced carcinoma will clear up the diagnosis.

Exception may be taken to the writer's classification of hyperplastic tuberculosis. If we were to include cases in which the laryngeal changes consisted simply of circumscribed hyperplasia or hypertrophy of parts of the mucosa we would have practically only Mackenzie's second case, Doleris' case, Foa's case, possibly Lermoyez's case, and Ariza's description of the condition. In all the other cases there was distinct tumor formation of some kind. I believe these cases should be included, particularly where there is absence of ulceration. Ulceration, however, may occur in some part of the larynx late in the course of the disease. When this occurs it does not affect the diagnosis of this form of tuberculosis in any way, because the characteristic lesions, the tumor formations, are *not* involved in the ulcerative process. In the writer's case, it is true, slight ulceration of the cords developed just before death, but the characteristic circumscribed hypertrophies of the ventricular bands and the thickened arytenoids remained unaltered. Tumor formation occurring in this form of the disease is, perhaps, nothing more than a circumscribed hyperplasia of the tissues, with the typical histological changes.

A review of the recorded cases of the forms of hyperplastic tuberculosis of the larynx described in this paper brings out some interesting facts. We find where the age of patients was mentioned that adults between the ages of thirty-one and sixty-three years were mainly affected. About an equal number of men and women had the disease. The youngest case in which this form of tuberculosis occurred of which I could find any record was in a girl, aged twelve years (Josephsohn's case[12]). Gougenheim and Tessier are among the only other authors who have described this form of tuberculosis in children, and Mackenzie[1] and Heinze[32] are among the few authors who have described tuberculosis of the laryngeal muscles. The favorite sites for the laryngeal lesions are, in order of frequency, the vocal cords, ventriculus Morgagni, ventricular bands, epiglottis, arytenoids, and the anterior commissure. There was only one case in which the tumor formation was limited to the interarytenoid fold, and only two in which subglottic

tumors occurred. The ventriculus Morgagni alone was involved in two cases, the cords alone in six, the ventricular bands alone in two, the epiglottis alone in some of Moser's[21] cases, and the anterior commissure alone in three. The epiglottis was involved with other parts of the larynx in three cases, the epiglottis and arytenoids together in one case, the arytenoids and cords together in one, and the ventricular bands and cords together in one. Mention is made of pulmonary tuberculosis in the majority of the cases. In the few cases before mentioned in which no evidence of pulmonary tuberculosis was found there is no mention of autopsies, so that this fact cannot be considered of much importance.

TREATMENT. Only one phase of the treatment will be considered, and that is a proper climate. I firmly believe, with Chappell,[43] that *any* chance should be taken in a good climate, rather than the best treatment in a poor climate. The climate in the Hudson Valley, near Albany, is certainly poor enough. For this particular form of the disease proper treatment in a good climate would be ideal, because ulceration is either *entirely* absent or does not develop until very late in the course of the disease. I am convinced, in considering my own case, that if the patient had gone to Denver and remained there he would be alive to-day. Another important point to consider in such cases is that in these early forms physical examination of the lungs is sometimes negative. They are certainly more favorable cases for a change of climate than the cases of laryngeal tuberculosis usually seen.

CONCLUSIONS. (*a*) Hypertrophic or hyperplastic tuberculosis of the larynx must be considered a distinct and unusual form of the disease.

(*b*) As a rule, there is no ulceration, but there *may* be some late in the course of the disease.

(*c*) Ulceration may be present at the same time as the hyperplasia of the tissues in some part of the larynx, but the characteristic circumscribed hypertrophies and tumor formations do not break down.

(*d*) It is practically always secondary to the pulmonary involvement, but there appears to be some evidence in support of the statement that particularly this form of tuberculosis may at times be primary.

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## OBSTRUCTION OF THE BOWELS AND PERITONITIS DUE TO A STRANGULATED MECKEL DIVERTICULUM.

BY JOHN H. GIBBON, M.D.,
SURGEON TO BRYN MAWR HOSPITAL AND TO THE PENNSYLVANIA HOSPITAL.

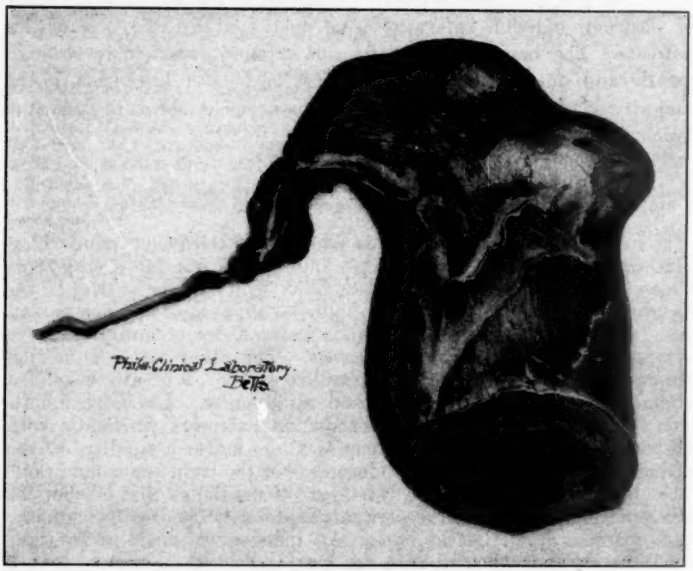
THE present-day method of early opening of the abdomen upon the presentation of certain symptoms which are considered indicative of operation has done much to advance the diagnosis of intra-abdominal conditions and to abolish the former frequent and indefinite diagnoses of "peritonitis" and "obstruction of the bowels." These terms for years have obscured a multitude of primary causes which are now being revealed and which formerly only came to light in the post-mortem room. Early operation has not only revealed the primary cause of the trouble, but it has done so at a time when the life of the patient could

be saved. It is seldom nowadays that an abdomen is opened for obstruction of the bowels, that the surgeon is compelled to make an artificial anus without discovering the cause of the condition, or that he is obliged to simply open and drain an abdomen for a suppurative peritonitis without finding and removing the primary condition which produced it; and yet how short a time since was this not the case? The findings on the operating table, much more than the findings in the post-mortem room, have taught us the early diagnosis of abdominal lesions; but, unfortunately, not enough to make us willing to withhold operation until a definite diagnosis is made, provided certain symptoms indicating operation are present. The physician or surgeon who must wait until he has made a positive diagnosis of an acute inflammatory or obstructive lesion before advising operation will save few of his patients. The cases of perforation in typhoid fever, of perforated gastric and duodenal ulcer, which have been saved have been, in the majority of cases, those in which there was some doubt as to the exact lesion.

The case here reported, although not one of early or correct diagnosis and treatment, is yet one which teaches their importance:

S. F., a girl, aged ten years, was admitted to the Pennsylvania Hospital on the night of November 10, 1902, and I saw her a very short time after her admission. Dr. Rosenthal, who sent the patient to the hospital, saw her first twenty-four hours before admission. The patient had been sick for one week with pain in the abdomen and progressive symptoms of obstruction of the bowels. The night before admission she was extremely ill with a temperature of 103°, a greatly distended abdomen, vomiting, and a weak and rapid pulse. Upon her admission she presented all the symptoms of an extensive peritonitis, with obstruction of the bowels. There was no marked rigidity of the abdomen, but there was more tenderness over the right lower quadrant. The abdomen was enormously distended. I concluded that the patient was suffering from a general peritonitis, probably due to appendicitis, and operated upon her at once. An incision was made in the right semilunaris, and when the cavity was opened there flowed out a quantity of turbid fluid. When the finger was introduced it came in contact with a mass of partially adherent intestine in the right iliac region. The pelvis, and in fact the whole abdominal cavity, was filled with a seropurulent exudate, and the small intestine was enormously distended. A large portion of the adherent bowel was covered with plastic lymph. After separating the adhesions there was exposed to view what was supposed to be the appendix, but it was observed that from the end of this tissue there passed a firm, fibrous band, which prevented its delivery. This fibrous band was traced in the direction of the umbilicus and then broken. The discovery of the fibrous band and the inability to bring the supposed appendix into the wound until it was divided caused me to believe that I was dealing with a Meckel's diverticulum. After the band was divided the diverticulum was easily delivered through the abdominal wound and the bowel to which it was

attached recognized as the ileum. The diverticulum was very much inflamed and covered with lymph; it was attached to the ileum about two feet from the cæcum, directly opposite the mesenteric attachment of the bowel. The portion of the bowel to which it was attached had been constricted by the diverticulum to such an extent that there was a distinct white ring extending over about one-half the circumference of the bowel, such as is frequently seen in strangulated hernia. It will be seen, therefore, that not only had the diverticulum produced an obstruction of the small intestine, but that it had itself been so compressed as to produce a degree of strangulation closely approaching gangrene. The diverticulum was about two inches long and of the same calibre as the bowel to which it was attached. In the process of separating and delivering the adherent bowel, a slight tear was made in




the ileum near the point of constriction; this was closed with two rows of continuous sutures. The diverticulum was then removed and this wound closed in a similar manner. The entire small intestine was then withdrawn, the lymph removed, and the abdominal cavity thoroughly flushed with quantities of salt solution. The intestines were then returned and a gauze drain was passed down to the floor of the pelvis and another about the sutured intestine, which was left directly under the wound in the abdominal wall. A large quantity of salt solution was left in the abdominal cavity and only three sutures placed in the wound.

During the operation the patient's condition became very much worse, the pulse becoming so rapid as to be uncountable. Free stimulation, however, resulted in a good reaction and the patient made excel-

lent progress until the seventh day. At this time the packing had been entirely withdrawn and the patient seemed in a fair way toward recovery. On the evening of this day, however, there was a rise of temperature and a complaint of pain in the abdomen. There was no distention of the abdomen, and the bowels moved, and there was no vomiting. On the morning of the ninth day the temperature was 104°, and the patient was vomiting and complaining of more pain in the abdomen. Ether was given and an exploration of the wound resulted in the evacuation of about an ounce of pus from the pelvis. Drainage was introduced, the patient's stomach washed out, and she subsequently made an excellent recovery.

So much has been written during recent years upon Meckel's diverticulum and the pathological conditions which it may give rise to, that a further discussion of them may seem unnecessary. Among the recent contributors to the subject is A. E. Halstead, who presents a most comprehensive study of sixty-nine cases which he has collected from the literature during the past ten years. The subject is a much more interesting one from the embryological and pathological than from the symptomatic and therapeutic point of view. Meckel's diverticula vary greatly in size and length and are capable of division into two classes: those which are free and those which have a fibrous extremity attaching them to the mesentery, the umbilicus, the abdominal wall, or to one of the abdominal viscera. The free variety is the one less likely to give rise to serious abdominal inflammation or obstruction of the bowels, and yet cases are on record in which an unattached diverticulum has produced most marked pathological conditions. One can readily understand how such a diverticulum may easily make its way into a hernial sac, as reported by Webster, or how it may become impacted with feces, kinked or twisted upon itself, giving rise to either gangrene or the formation of a cyst, as reported by Taylor. Probably, however, the most frequent and serious lesion results from invagination of the diverticulum, which, of course, is not apt to take place when it is attached, and which usually produces a secondary intussusception of the small intestine. Numerous cases of this kind have been reported and probably no variety of intussusception is so difficult of reduction or so frequently requires intestinal resection. A recent case of this nature is reported by Dobson. Cases of perforated typhoid ulcer, situated in Meckel's diverticulum have also been reported, but must be looked upon simply as coincidences and not in any way due to the anomalous nature of the portion of bowel affected. Recently in operating upon a case of appendicitis I met with one of these unattached diverticula coming from the ileum, about two feet from the cæcum, of the same calibre as the bowel, and about one and a half inches long. Of course, the likelihood of trouble increases with the length of the diverticulum.

The attached diverticulum may be the seat of inflammation resulting in strangulation and gangrene, or it may produce any one of a number of forms of intestinal obstruction. It has been claimed by certain authorities that the condition is frequently associated with other malformations, such as hare-lip and club-foot, etc., but this has certainly not been borne out by recent collections of cases. Other malformation was found but once in Halstead's table of sixty-nine cases. As Meckel's diverticulum represents the vitelline duct extending from the primary intestinal canal to the umbilical vesicle, it is natural to expect to find the majority of the diverticula attached in the neighborhood of the umbilicus, and many authorities state that this is true. There is, however, some difference of opinion on this point, others claiming that mesenteric and abdominal wall attachments are more frequent. Briddon has reported a most interesting case of prolapse of the ileum through an unclosed diverticulum of Meckel in an infant one month of age. This case was operated upon and made an excellent recovery. Another case of diverticulum patent at the umbilicus is reported by Hubbard. Kammerer reports three cases of obstruction due to diverticula, and one is unique in that the sigmoid was the portion of bowel obstructed.

The diagnosis of obstruction due to Meckel's diverticulum is next to impossible, although certain symptoms are looked upon as suggestive of the condition. The two most important of these are visible peristalsis and localized meteorism. In addition to these a history of previous attacks of partial obstruction is of value. Not only is the diagnosis difficult before the abdomen is opened, but in a number of cases reported the true condition was not discovered at the time of operation, but was found post-mortem. Of the acute inflammatory conditions of the abdomen with which strangulated and inflamed diverticula have been confused is acute appendicitis. This was true in the case I have just reported and was true in three cases reported by Erdman. Two of these cases recovered. Halstead found the mortality of the cases operated upon for obstruction was 68.1 per cent. —an exceedingly high mortality.

One can say little about the treatment, which, of course, consists in the removal of the diverticulum; but one point which I should like to emphasize is the fallacy of giving laxatives and purgatives for acute obstruction of the bowels, whatever the cause. It may seem unnecessary to make such a point, but you all know with what regularity these patients are given laxatives of all kinds and in all doses. The patients, if they are not to be operated upon, had best be given absolutely nothing by the mouth, and fed by the rectum. Laxatives but aggravate the condition and reduce the patient's chances of recovery. The only treatment is the removal of the mechanical cause of the obstruction.

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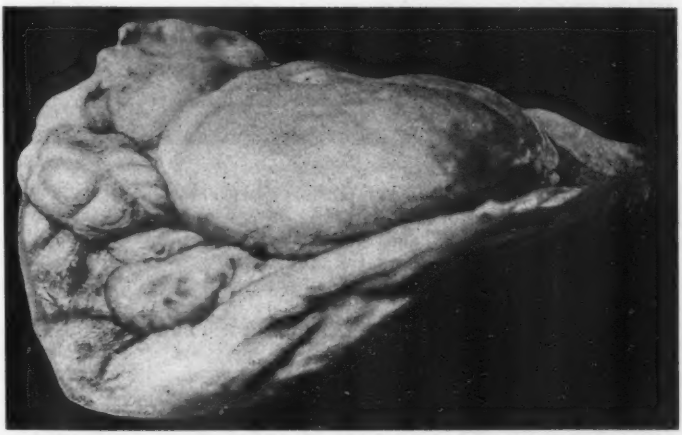
## TWO CASES OF RETROPERITONEAL HERNIA.

BY LOUIS J. MITCHELL, M.D.,
OF CHICAGO.

WHILE, strictly speaking, there are four forms of retroperitoneal hernia, the cases herewith reported all belonged to that variety which occurs into the duodenal fossæ.

CASE I.—Mrs. M. J., aged thirty years, colored, was shot through the heart, dying immediately. At the necropsy, on making the usual median incision and cutting through the abdominal wall, instead of

FIG. 1.



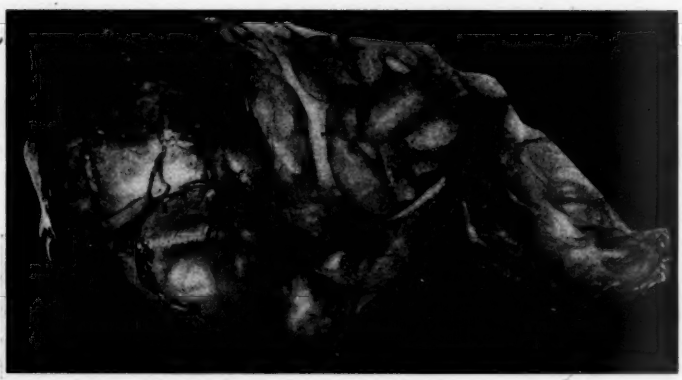
coming upon the omentum, or the intestines, a white, glistening sac (Fig. 1) was found, which seemed at first to be a mesenteric cyst or an ovarian tumor. After reflecting the abdominal walls and tracing

the relations, however, it was discovered to be a case of retroperitoneal hernia.

The mass, which measured 17.5 cm. by 27 cm., reminded one of the gravid uterus except that it was flattened in front. It was situated in the centre and left side of the abdomen, surrounded by the colon, extending below nearly to the promontory of the sacrum. The omentum, which was very thin and but slightly developed, was rolled up between the sac and the transverse colon. At the lower aspect of the sac on the right was an elliptical opening 5 cm. by 7.5 cm., from which 10 cm. of the lower part of the ileum escaped obliquely to join the cæcum. The remainder of the small intestine was contained within the sac.

The sac was smooth and shining; the walls thick, but translucent, so the intestinal coils could be discerned; the walls of the sac contained numerous bloodvessels, but little fat. The sac was free except on the left and above, and several folds ran off from its border and were lost in the surrounding peritoneum.

FIG. 2.



The orifice of the sac was situated low down close to the cæcum and looked forward and to the right (Fig. 2). The upper margin of this orifice was thick, fibrous, and opaque, becoming thinner below. The inferior mesenteric vein bordered the opening; the colica sinistra artery ran at some little distance from the free border. The vein was about the size of a goose-quill.

The coils of intestine in the sac were patent and moderately distended with gas, but were strongly adherent, so only part of them could be pulled out. The part that was mobile showed no changes in the mesentery, or in the bowel itself.

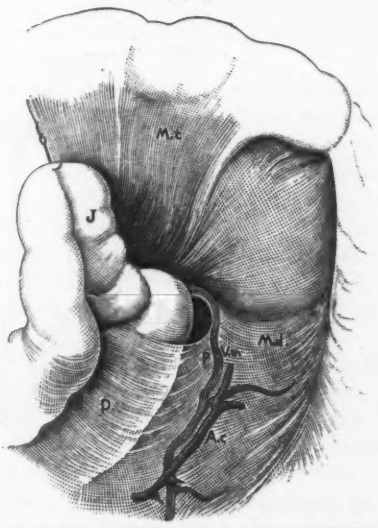
As regards the large intestine, the cæcum, ascending and transverse colons were in their proper places; the descending colon was in front of the sac, having been pushed forward; the rectum was normally situated. There was no congestion of the abdominal viscera or hemorrhoids.

Nothing abnormal was noted in the outward appearance of the abdomen. The walls were somewhat pendulous, but as striæ were visible this may have been due to past pregnancies.

This is a well-marked example of the mesenteric hernia of Sir Astley Cooper, the retroperitoneal hernia of Treitz, and the duodenal hernia of Jonnesco, of which less than one hundred examples have been recorded since 1776.

At first considerable confusion arose from the cases being described as "preternatural pockets, peritoneal defects, anomalies," etc. This confusion continued until 1857, when by the publication of the classical

FIG. 3.




The duodeno-jejunal fossa. (Jonnesco, after Treitz.)

D, ascending duodenum. J, jejunum. P, duodeno-jejunal fold. V.m, inferior mesenteric vein. A.c., colica sinistra artery. M.t., M.d., transverse and descending mesocolons.

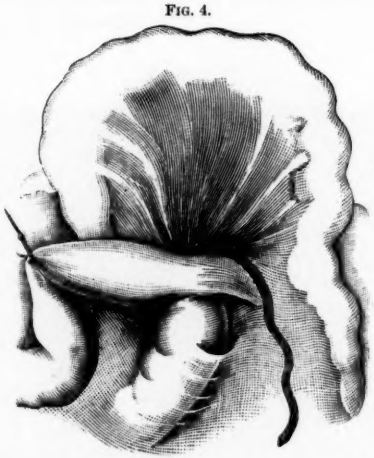
work of Treitz (*Hernia Retroperitonealis*) the condition was placed on a sound anatomical basis. Treitz met with eight cases between 1847 and 1854, and from a study of these, and of eighteen cases previously mentioned by other authors, came to the conclusion that the hernia is always formed in a fossa of the duodenal region, which he called *fossa duodeno-jejunalis;* that is, it is always acquired, and that it can become strangulated.

According to this author, three things are essential for the formation of this variety of hernia:

1. A dilatable excavation of the peritoneum.
2. A resisting ring.
3. A mobile intestine pressing against the ring.

*The dilatable excavation* of the peritoneum is, according to Treitz, furnished by the fossa duodeno-jejunalis. To see this fossa it is necessary to lift up the transverse colon and draw the small intestine to the right, when the duodeno-jejunal angle will be visible. When the fossa is present a membranous fold is seen passing from the anterior surface of the lower part of the duodenum to be inserted at a variable distance on the parietal peritoneum, thus forming a little pouch—the fossa duodeno-jejunalis, or inferior duodenal fossa (Fig. 3). The opening looks directly up and the fossa will usually accommodate the finger-

FIG. 4.



The inferior and superior duodenal fossæ. (Jonnesco.)

The inferior mesenteric vein at some distance from the inferior fossa, runs along the left border of the superior. Above is seen the transverse colon and mesocolon lifted up; on the left the descending colon, on the right the ascending duodenum, the two duodenal folds, and the fossæ which they limit. The jejunum is drawn to the right as well as the mesentery, under which the duodenum disappears.

tip to the second phalanx; sometimes it will hold two or even three fingers. The inferior mesenteric vein and the colica sinistra artery, as a rule, border the orifice on the left. Occasionally there is a superior fossa instead, which has the same relation except that the opening looks down, and sometimes the two fossæ are present at the same time (Fig. 4).

Opinions differ as to the frequency of occurrence of the fossa duodeno-jejunalis, thus: Waldeyer gives 70 per cent., Gruber 66 per cent.,

Treves 48 per cent., Debierre 50 to 75 per cent., and Jonnesco 75 per cent. for the inferior and 50 per cent. for the superior. The writer examined 1000 fresh adult bodies, with a view to ascertaining in how many it was present, with the following results:

| Males. | | Females. | |
|---|---|---|---|
| Bodies examined | 821 | Bodies examined | 179 |
| Absent | 513 | Absent | 101 |
| | 308 | | 78 |

The results are less than those quoted, but the fossa was carefully searched for and nothing counted as such unless it admitted the finger-tip.

*A resisting ring* is furnished by the vascular arcade, composed, as before stated, of the inferior mesenteric vein and colica sinistra artery. This acts in the same manner as the inguinal and femoral rings for external hernias (Treitz).

*A Mobile Intestine.* According to Treitz, the increase of abdominal pressure so favorable for the production of external hernias has no effect on these forms, neither has dilatation by gas or food. Shaking of the body, on the contrary, especially if continuous and regular, as in walking, dancing, and riding, are prime factors, for in such cases the intestines press by their weight on neighboring viscera. When the hernias are of small volume the jejunum alone is involved, when of large dimensions the ileum is involved also. Complete hernias are found in adults and old persons; the incomplete in the young, as a rule.

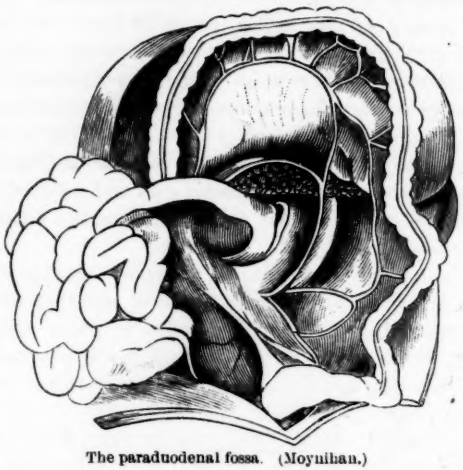
In a recent work,[1] Mr. B. G. A. Moynihan, of Leeds, refers "to the exuberant and redundant nomenclature that has been adopted by the various writers at different periods. The term that has perhaps been, on the whole, most subjected to abuse is 'duodeno-jejunal.' It has been applied indiscriminately to every variety of fossa found in this region, to fossæ which are strictly duodenal, to fossæ which are jejunal, and to fossæ which are neither; but more and worse than this is the adoption by one author of a name suggested by an earlier writer for a fossa quite different from that which is being described. The result is chaotic." Mr. Moynihan then carefully describes no less than nine different fossæ in the duodeno-jejunal region, and gives his reasons for believing that the left variety of duodenal hernia arises in the paraduodenal fossa, or fossa of Landzert (Fig. 5).

This "is situated to the left, and some distance from the ascending limb of the duodenum. The fossa is caused by the raising up of a fold, the plica venosa, by the inferior mesenteric vein—a fold which may not inaptly be described as a mesentery of that vein. Behind,

[1] On Retroperitoneal Hernia, London, 1899.

the sac is bounded by the parietal peritoneum, covering the psoas, the renal vessels, the ureter, and a portion of the left kidney. The orifice of the sac is wide, and looks down and to the right; the blind extremity is directed upward and slightly to the left. The width of the orifice

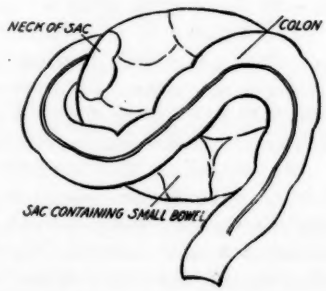
FIG. 5.



The paraduodenal fossa. (Moynihan.)

depends, of course, upon the distance between the inferior mesenteric vein and the duodeno-jejunal flexure—a distance which is capable of great variation" (Moynihan).

FIG. 6.




It seems to the writer that this opinion is well founded. If the inferior duodenal fossa (Treitz's fossa duodeno-jejunalis) were the seat, duodenal hernias should be much more common, since this inferior fossa is the most frequent of these peritoneal pouches.

In a conversation with the late Professor Wyatt Johnson, of Montreal, he stated that he had also met with a case of retroperitoneal hernia, and was good enough to send the following description and a rough sketch made at the time (Fig. 6).

Case II.—"In a little girl of four years, whose death was due to burns, at the post-mortem on opening the abdomen the peritoneum was smooth and shining, the vessels not injected. The small intestine was seen to lie in a separate peritoneal pouch behind the general peritoneal cavity. The opening of this was as large as the palm of the hand, with smooth, thickened edges, and was formed by part of the mesentery near the jejunum. The opening seemed to be the right side; the whole of the jejunum and ileum lay within this sac. The head of the cæcum and appendix lay outside it free and somewhat raised above the level of the right iliac fossa. The ascending colon passed over the point of the sac obliquely and to the left. The sigmoid flexure and rectum lay somewhat to the right of the median line at the brim of the pelvis."

In Leichtenstern's[1] classical and frequently quoted article on intestinal obstruction, he states:

"Under favorable circumstances, if the hernia is of notable size, I consider it possible to make a probable diagnosis, not a positive one, but still one that is based on reasons. The circumscribed globular distention of the mesogastrium, with retraction of the region corresponding to the colon; the firm, elastic, spherical lump which can be distinctly felt when the abdominal wall is thin, giving the impression of a large, somewhat movable cyst, and extending from the mesogastrium principally to the left; the peculiarity that this well-defined tumor always yields a sonorous note on percussion, and clear intestinal sounds on auscultation; also the presence of hemorrhoids and the loss of blood from the rectum in consequence of compression of the inferior mesenteric vein, permit, when taken in connection with the subjective troubles indicating chronic disease of the abdominal organs, a probable diagnosis to be made. In case laparotomy is performed to relieve acute strangulation, profuse hemorrhage would be caused, when the hernial orifice was enlarged, by the division of the arteria colica sinistra and the vena mesenterica inferior, which latter is usually much dilated."

Moynihan points out that hemorrhage may be avoided by dividing the neck of the sac between two ligatures. So far only one case (Staudenmeyer's) has been diagnosed during life, but for some reason was not operated on.

The condition may be said to be a *trouvaille* of the dissecting table or the post-mortem room. Most of the cases have occurred in males. In some ten or twelve cases death was due to acute intestinal obstruc-

[1] Ziemssen's Cyclopædia of the Practice of Medicine, New York, 1876, vol. vii. p. 549.

tion. In many individuals the hernia seems to have had no effect on the duration of life; one subject was seventy-four, several others over sixty years of age. At the other extreme cases have been seen in infants of two weeks and two months, respectively. It does not appear to have yet been found to be congenital, though Moynihan claims there is no reason why it could not be.

Three cases have been successfully operated on (those of Sonnenburg, Tubby, and Neumann).

Further information may be found in Jonnesco's work,[1] as well as the later and much less diffuse one of Moynihan, which has a good bibliography.

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## SPLENIC ANÆMIA. A REPORT OF THREE CASES.

BY J. A. SCOTT, M.D.,
PHYSICIAN TO THE PENNSYLVANIA HOSPITAL, PHILADELPHIA.

DURING the past five years the medical journals of both England and America have contained several important articles upon the subject of splenic anæmia. Prominent among them are those of Sippey,[1] Osler,[2] A. H. Wentworth,[3] Samuel West,[4] J. S. Fowler,[5] and J. L. Morse.[13] The last four writers deal with the association of splenic enlargement and anæmia in infancy, and their observations have decidedly cleared the misty atmosphere that has hung around some of the diseases of childhood.

The American writers are in entire accord as to their main conclusions, based upon the observations of cited cases. A brief abstract of the conclusions arrived at follows:

[1] Hernies Internes Retroperitoneales, Paris, 1890.

1. There is no relationship between the anæmia and the enlargement of the spleen, liver, and the lymph glands. Cases with identical lesions of the spleen show varying degrees of anæmia and leucocytosis (Wentworth and Morse).

2. The blood shows a constant tendency to revert to the fetal type; the morphology of the red cells varies with the degree of anæmia, and not with the condition of the liver and the spleen. Normoblasts and megaloblasts are frequently found, with but little anæmia (Morse).

3. The leucocytes are frequently increased in number (regarding 14,000 as the normal), and usually correspond to the degree of anæmia (Fowler).

Morse thinks there is no relation between the reduction in reds and the degree of leucocytosis; thus, he finds a low red count with leucopenia, and a high red count with a decided leucocytosis.

4. The hæmoglobin index is always reduced.

5. Splenic anæmia and von Jaksch's disease are to be regarded as secondary anæmias.

6. The enlargement of the spleen, liver, and the lymph glands is not due to the change in the blood, but are all the result of a common cause—disturbance in nutrition.

There are, therefore, some points of difference in the symptom-complex as manifested in infants and adults:

1. The infrequency of hemorrhages from the mucous membranes in the former; its comparative frequency, especially from the stomach, in the latter.

2. The tendency of the splenic tumor to disappear under treatment in the infant; its persistence or gradual enlargement in the adult.

3. The presence of a leucocytosis in infancy; a leucopenia or a normal leucocyte in the adult. (Rarely a leucocytosis. Case I.)

There have also been not a few cases reported occurring in adults and children. S. M. Hamill,[6] A. O. J. Kelly,[7] P. L. Daniel,[8] J. E. Talley,[9] N. E. Brill,[10] Bovaird,[11] Geo. Peacocke,[12] and A. L. Benedict,[13] have all published cases showing the different types of splenic enlargement associated with definite anæmia, so that we can more concisely define the disease under consideration. I can do no better than quote Dr. Osler's definition of anæmia splenica chronica as given in his article in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES:[2] "A chronic affection, probably an intoxication of unknown origin, characterized by progressive enlargement of the spleen, which cannot be correlated with any known cause, as malaria, leukæmia, syphilis, cirrhosis of the liver (primary splenomegaly); anæmia of a secondary or chlorotic type (leucopenia); a marked tendency to hemorrhage, especially from the stomach, and in many cases a terminal stage with cirrhosis of the liver, jaundice, and ascites (Banti's disease)."

With the firm belief that cases of obscure disease can best be studied from the statistical standpoint, I desire to add to those already reported, the following cases of splenic anæmia seen during the past several years.

Case I.*—J. C. H., aged thirty years; by occupation a ship steward and cook; admitted to the Pennsylvania Hospital (No. 3260) on January 7, 1903, complaining of a leg ulcer on the lower inner side of left leg. His father was a Canadian, with some admixture of Indian blood; mother, Irish. He was born near Chester, Pa., where he lived until he was seventeen years old. During his boyhood he had frequent attacks of chills and fever. Since 1885 he thinks his skin has been yellowish in hue, sometimes being more deeply so than at present. During and after the malarial attack in December, 1885, it was noted that his spleen was much enlarged, and it has so remained ever since.

To better his health he shipped on coasting steamers as a cabin boy from 1890 to 1893, and finally took to sea going vessels in 1893, and has since remained upon them in the capacity of a ship steward. In October, 1894, he had scurvy, "his muscles becoming soft and flabby and the teeth loose," and at that time there first developed an ulcer upon the left leg, which was slow in healing, and which has several times broken down since then. From December 12, 1895, to April 14, 1896, he was a patient in the Pennsylvania Hospital under the care of Dr. J. M. Da Costa (*History*, 1773). The splenic measurements were then identical with its present size. The blood count was, then: erythrocytes, 2,048,000; leucocytes, 12,000; hæmoglobin, 34 per cent. During his four months' stay in the hospital the blood count was but little changed, excepting an increased leucocytosis (20,000). No differential count was then made. One hyaline body (malarial) was reported to have been found, though subsequent examination failed to show parasites. The condition of the heart and the urine was identical with the present state. Upon his discharge from the hospital, a diagnosis of "malaria and splenic leukæmia" was made.

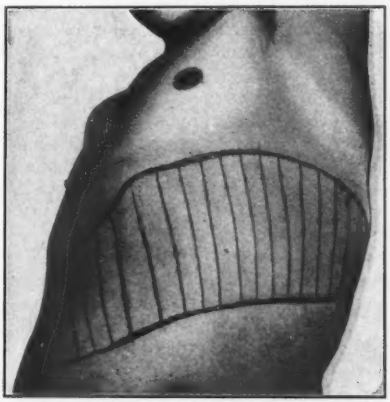
He states that he has had typhoid fever three times; the first attack in July, 1888, in Philadelphia, duration of two months, and under the care of Dr. J. M. Anders. The second and third attacks occurred in February, 1891, and July, 1892, in the marine ward of the German Hospital, duration of two to three months each. Pneumonia he has had twice: double pneumonia in the Bellevue Hospital, New York, in November, 1896, very ill for six weeks; again in 1899, at the Presbyterian Hospital, New York, under the care of Dr. Walter James, in hospital four weeks. He states that he has had malarial attacks (chills, with fever and sweats), during which malarial organisms were found in his blood in 1898, 1899, and in November, 1902. It is doubtful if these attacks have really been malaria. He has never had hemorrhages from the nose, stomach, or bowels. He is not an alcoholic, and he denies all forms of venereal disease. The digestion is usually good, and bowels move daily.

*Condition on Admission.* He is a short, stocky man, with straight black hair and oval eyes, and a curious sallow skin with a distinct lemon tinge; in fact, he much resembles a Mongolian; there is no

* This case was shown before the Medical Section, College of Physicians of Philadelphia, March 9, 1903.

unusual pigmentation on the face or body. He has several carious teeth, but the mouth is otherwise in good condition. When he stands erect the abdomen is protuberant. The chest is well formed; the lungs are normal. Heart: Apex in fifth interspace, just under the nipple. The outline of cardiac dulness is the right border of sternum, the third interspace to the midclavicular line. There is a soft, blowing, systolic murmur at the apex, transmitted slightly to the left. A murmur of the same quality is present at both aortic and pulmonary cartilages, and the second sound of each accentuated, the aortic, however, more so than the pulmonary. The liver dulness begins in the midclavicular line at the seventh rib. Its sharp, thin edge can be felt in the right parasternal line, several fingers' breadth below the costal margin. Its surface is smooth, and as it disappears under the left costal margin it is in close proximity with the spleen. The spleen is exceedingly large,

FIG. 1.



Chronic splenic anæmia. The outline represents the area of the spleen.

the upper border of dulness beginning in the seventh interspace in the midaxillary line. It extends downward and forward, crossing the median line above the umbilicus, its tip reaching to a point midway between the umbilicus and the right iliac crest. The lower edge curves away and downward, and lies within a finger's breadth of Poupart's ligament on the left, and almost rests upon the left anterior spine of the ilium. (See Fig. 1.) Its surface is hard and not nodular. The notch is felt on the anterior edge above the umbilicus; just above this point a small, soft nodule can be felt which seems to be attached to the abdominal wall. After some manipulation it can be displaced. It is probably a small ventral hernia filled with omentum. There is no ascites, no œdema of the legs; there is marked pigmentation on the right shin, which is of brown color. The leg ulcer is superficial with slightly raised edges, with bluish discoloration; the granulations are pale and sluggish. The urine is 1008, light in color, acid; contains a

trace of albumin, no sugar; on microscopic examination a large quantity of uric acid with a few hyaline casts were found.

His blood was counted at intervals of every two weeks during his stay in the hospital. The first count was: erythrocytes, 2,440,000; leucocytes, 9050; Hb, 60 per cent. A differential count showed polynuclear, 54.4 per cent.; small lymphocytes, 36 per cent.; large lymphocytes, 1.6 per cent.; transitionals, 3.6 per cent.; eosinophiles, 4.4 per cent. Six normoblasts were found in counting 250 leucocytes. No malarial organisms were present on admission, or at any time subsequently. During his stay in the hospital the blood condition improved slightly, the erythrocytes rising to 3,208,000; the hæmoglobin to 58; leucocytes, 15,475; numerous normoblasts were found, and one megaloblast just before his discharge.

During February his vision, which was poor on admission, failed rapidly because of increasing opacity of the lens of the right eye, while the left eye also showed a beginning cataract. The examination of the fundus, made by Dr. George C. Harlan, showed no hemorrhages and was reported as normal. The temperature during his stay in the hospital was mainly subnormal, except upon two days, upon one occasion rising to 100.2° F. The leg ulcer, upon his discharge, March 31st, was almost healed, his main complaint being the loss of his eyesight, due to cataract formation. There was no evidence of hemorrhage from any mucous membranes during his stay in the hospital.

Case II.—Rosie N., aged thirteen years; a school-girl; hospital No. 3079; admitted to Pennsylvania Hospital on December 23, 1902. Her parents are living, and the child has been in the United States but one month. She has been sick for two months, diagnosed as æstivo-autumnal malaria and treated with the hypodermic injection of quinine, without results. Her symptoms were headache, cough, and pain in the left side of abdomen. No fever present. It was stated that she passed blood from the bowel one week before admission.

*On Admission.* A well nourished girl, with pallid mucous membranes; moist, slightly coated tongue; the axillary, postcervical, and inguinal glands are slightly enlarged. The lungs are healthy, and the heart is normal in size, and the sounds clear. The liver is normal in outline, while the spleen is much enlarged (see Fig. 2), extending beneath the costal margin in the midclavicular line, and the tip reaches just below the umbilical level; the posterior border disappears beneath the costal cartilages in the midaxillary line. The surface is smooth and firm, edge sharp, and the organ freely movable. The extremities are normal. No unusual pigmentation.

*The Blood.* Erythrocytes, 31,120,005; leucocytes, 3600; Hb, 55 per cent. A differential count results as follows: polynuclear, 58.4 per cent.; small lymphocytes, 26.8 per cent.; large lymphocytes, 6.8 per cent.; transitional forms, 6 per cent.; and eosinophiles, 2 per cent.

During her stay she passed a round worm and some undigested curds in the stools, while the temperature was irregular for two or three days. There were no hemorrhages from any source. There was decided improvement under increasing doses of Fowler's solution. The spleen was unchanged in size on her discharge, on January 24, 1903.

Case III.—Charles L., aged thirty-two years; an Italian laborer; admitted to the Pennsylvania Hospital October, 1890; hospital No.

1954. He has been in America for two years. When fifteen years old had a malarial fever, and at twenty-two a continued fever for several weeks; these have been the only sicknesses. He complains of palpitation of the heart for five months, with some pain over the pubis and about the lower part of chest, and some loss in weight. He never had hemorrhage from any source, and no diarrhœa; denies venereal disease.

*On Admission.* A large-framed, muscular Italian, with sallow skin and pale mucous membranes; the first molars and bicuspids in lower jaw are carious. The inguinal and axillary glands are decidedly and

FIG. 2.

Splenic anæmia. Duration of anæmia short. Outline shows the size of spleen below the costal margin.

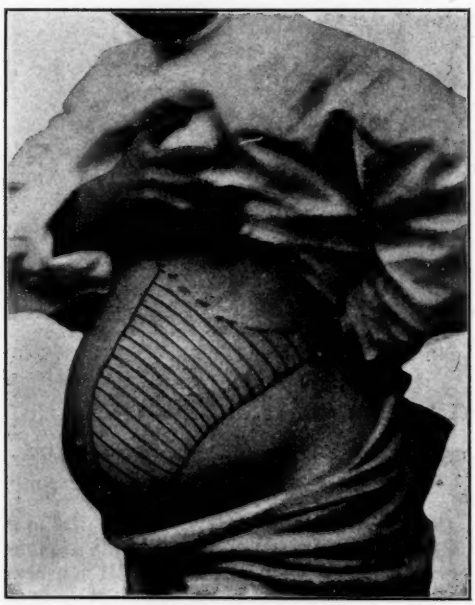
the postcervical slightly enlarged. The chest is broad and deep, with normal breath sounds; the heart is slightly increased in its lateral diameter (11 cm.), with soft systolic murmur at the apex and both aortic and pulmonary areas (hæmic murmur). The liver normal in size, while the spleen is very much enlarged, the dulness beginning in midaxilla at seventh rib, and emerging beneath the costal cartilages in the midclavicular line, extends to the level of the umbilicus; it is hard and the notch can be felt. There is no œdema of the legs, and no pigmentation of the skin. An anæmia of chlorotic type is present; the erythrocytes are reduced to 2,084,000; the leucocytes, 4900; and

the Hb is 15 per cent. He remained in the wards until November 30th; during this interval the blood was counted six times, the results showing a rise in the erythrocytes to 3,360,000, and the Hb to 35 per cent.; leucocytes, 4400. No nucleated reds were found; the differential count normal; slight poikilocytosis. The temperature was usually subnormal, though on one occasion it rose to 100° F., and at irregular inervals was 99° F. in the evening. The bowels were normal. The treatment consisted in the administration of Blaud's mass, 5 to 15 grains t. i. d., and increasing doses of Fowler's solution. At no time were malarial organisms found, and no definite cause for the anæmia discovered. The spleen remained unchanged in size on his discharge.

The following case illustrates another aspect of splenic enlargement, and perhaps should be classified under the splenic anæmias, though the blood symptoms are wanting.

CASE IV.—Varione F., aged thirty-five years; housewife; born in Italy. Previous health fairly good; has one child, aged eight years.

FIG. 3.



Primary splenomegaly. Enormous spleen, with no anæmia. Outline shows the splenic area.

Scanty, but regular menstruation. For two years she has had slight pain in the abdomen, and noted its gradual enlargement. Occasionally

she has chilly sensations, followed by fever; admitted to Pennsylvania Hospital January 8, 1903; hospital No. 3266.

*On Admission.* A well-nourished, healthy-looking woman, with clean, moist tongue; no evidence of anæmia; the lungs and heart are normal; the lymphatics are not enlarged. The liver is of normal size, while the spleen is unusually large (see Fig. 3), extending to the median line, and as far as the iliac crest. It is smooth, firm, and slightly tender along the anterior edge; its transverse diameter below the costal margin is 16 cm. No œdema of extremities. No ascites. Menstruating at present, and has temperature of 99.4° F.

*The Blood.* Erythrocytes, 4,656,000; leucocytes, 4650; Hb, 80 per cent.; the differential count is practically normal; polynuclear, 75 per cent.; small lymphocytes, 11.66 per cent.; large lymphocytes, 8.33 per cent.; transitional forms, 3.33 per cent.; and eosinophiles, 1.66 per cent. The urine is 1018, and contains neither albumin nor sugar. A week later the red cells had risen to 51,440,005 and the Hb to 97 per cent. On account of the unusual motility of the spleen, I had a tight abdominal band applied, and we were not able to keep her in the ward after January 24th. In this case the splenic dulness began low—at the ninth rib—so that it is probable that the enlarged spleen was ptosed decidedly; the ability to move it about readily is also in favor of this view. I attributed her symptoms to the weight and mobility of the spleen, and, in the absence of any anæmia, considered the enlargement in part due to a kinking of the splenic vessels; this is the second case of such unusual enlargement of the spleen without anæmia I have seen in Italian women; in both cases the spleen was mistaken for a pelvic growth by the attending physicians and sent to hospital for operation. In one the actual diagnosis was not made until exploration of the abdomen showed the tip of the enormously enlarged spleen to be adherent to the left tube and ovary. The pathology of the specimen was a hyperplasia of the stroma; the splenic vein was swollen the size of the placental cord and much resembled it in appearance.

TREATMENT. Results of medicinal treatment in splenic anæmia have not been satisfactory; measures to improve the anæmia, the administration of iron and arsenic, with plenty of digestible nourishment and fresh air, are indicated. In some cases, especially in children, rapid improvement in the blood follows. In adults the enlargement of the spleen usually persists, and its size alone is a cause of considerable discomfort.

This has led to surgical interference and the removal of the spleen.

Harris and Herzog[14] have reported nineteen cases of splenectomy in splenic anæmia, with fourteen recoveries. I have collected since their report six additional cases, with four recoveries (Warren,[15] Peacocke,[13] Blanquique,[16] J. P. Bispham,[17] Cushing and Halstead.)[9] The fatal result is usually due to hemorrhage.

REMARKS. None of the foregoing cases can be said to be typical, for, though all of them present a chlorotic anæmia and an enlarged spleen, in but one of them has hemorrhage from the mucous membranes occurred (Case II.), and that before admission to hospital.

In two of the cases (II. and III.) the superficial lymphatics were somewhat enlarged, though in neither of them were there other signs of syphilis. In all the cases, including the last, malaria can be regarded as one of the factors in the splenic enlargement; three of the four cases are Italians, in whom splenic enlargement is an extremely common physical sign; three of them have distinct histories of so called malarial attacks. All the cases show a marked tendency toward chronicity, Case I. certainly having a history of at least eighteen years' duration. The first three cases, no other cause having been discovered for the symptoms, are therefore diagnosed as splenic anæmia.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## SPONDYLITIS DEFORMANS.


BY JOHN RUHRÄH, M.D.,
OF BALTIMORE, MD.


IT has been my good fortune to have seen a number of cases of spondylitis deformans both here in America and in the hospitals abroad. I am convinced that the disease is more common than the text-books would have us believe, and that many cases are not diagnosed, through the fact that the physician has either no knowledge of the affection, or else only a very vague idea of what it is. For the purpose of calling attention to the disease, I report a case which came under my care last summer:

*Clinical History.* Patient is a white female, aged twenty-two years.
*Family History.* Father, mother, and two brothers living and healthy. One brother died in infancy. There is no history of any special diseases in her ancestors.

*Past History.* Whooping-cough and chickenpox in early childhood. Diphtheria at the age of ten years. German measles about two years ago. At the age of fourteen years was thrown from a horse, striking on the right hip and shoulder. No bones were broken, and she recovered in about three weeks. About three years ago fell from a wagon, striking her face. She sustained no injury of any moment and recovered promptly. At the age of fifteen years she began to suffer with what was supposed to be rheumatism. The attacks of pain lasted from one to four weeks, and were worse in winter. The pain started in the right hip (the injured one) and then extended to the left hip, shoulders, and neck. Soon after her second fall, three years ago, her back became stiff. This she attributed to the fall. Since that time she has had pain more or less constantly in her back, shoulders, and hips, and especially in her neck. Menstruated at the age of thirteen years. This was regular for the first four years, but since then has menstruated every three or four weeks, and the flow has been irregular in quantity as well as time.

*Present Condition.* Back, neck, shoulders, and hips feel stiff and are slightly painful. The pain is usually on pressure or on movement. The region of the atlas and the axis are especially tender and painful. The entire spine is tender to the touch, but not markedly so. Experiences difficulty in lying down, as she has pain in almost every position. When lying on her back has pain along her spine; lying on her side the shoulders pain, and if on the right side the hip as well. When she lies face downward the neck pains.

She is an average-sized girl, but is at present somewhat emaciated. The legs and arms are quite thin. About the neck and shoulders the atrophy of the muscles is most pronounced. The atrophy involves all the muscles about the shoulders and neck, with the possible exception of the trapezius. The deltoid is included. There is no fibrillation. The trapezius along the neck is thickened and hard, and seems to be filled with deposits resembling those of myositis ossificans. The muscles under the trapezius seem also to have similar deposits in them, giving the entire neck a hard, bony feel. None of the other muscles are affected in this way.

The spine is stiff and movements are practically impossible, although there is the very slightest amount of motion between some of the vertebræ. When sitting she cannot be bent forward, the spine being like one solid piece of bone. The head cannot be rotated, except very slightly to the right. Forward, backward, and sidewise movements can be made with the head, but they are very much restricted.

The shoulder-joints are both affected equally. The arms cannot be raised above the horizontal, and, unaided, not even that far. Below the horizontal the movements are fair, although restricted. On attempting to raise the arm above the level of the shoulder or in making any wide motions, she complains of pain, and a distinct grating can be felt.

The hip-joints are both affected, but the right somewhat more than the left. The legs can be extended fairly well and flexed to about a right angle. Abduction, adduction, and rotation are very much restricted. The movements within the limits of what she is able to make for herself are painless; any attempt at more extensive movements is ended with pain. She walks, usually with a cane, but she can get along unaided. Her steps are short, and progression slow and difficult.

There is no involvement even to the slightest degree of any of the other joints. For three weeks she was treated with massage, passive movements, and hot baths, together with the internal administration of arsenious acid. During that time there was no improvement at all, except as regards her general condition. She gained in weight, and her general appearance was much improved.

*January* 15, 1903. She remains well, except for the condition as noted above, which is unchanged.

NOMENCLATURE. The inflammatory conditions of the spine accompanied by ankylosis have not always been defined with sufficient clearness, and there exists, even now, considerable difference of opinion as to the exact nature of these affections. The truth, probably, is that there have been grouped together a number of affections differing somewhat as to their symptoms and greatly as to their cause.

In this country the condition has received but scant attention. Goldthwait calls it "osteoarthritis of the spine" or "spondylitis deformans."

In Germany Strümpell described cases under the name of "chronic ankylosing inflammation of the spinal column and hip-joint" (Chronische anklosirende Entzündung der Wirbelsaüle und Hüftgelenke) and this name has also been used by Bäumler, Hoffa, Bregman, Hoffmann, and others, with the omission of the reference to the hip-joint; Köhler and Beneke call it "spondylitis deformans;" Oppenheim uses the term "arthritis deformans of the spine;" Beer names it "rigidity of the spinal column."

In France, Marie and others unite in calling it "spondylose rhizomelique."

In Russia, von Bechterew, who has written extensively on the subject, calls it "ankylosing inflammation of the spine," and he describes what he thinks to be a separate affection under the name of "stiffness of the spine" (Steifigkeit der Wirbelsaüle). Popoff uses the term "neuropathic curvature of the spinal column."

In England the term "spondylitis deformans" is most generally used, while the name "osteitis deformans" has sometimes been improperly applied to it. This last name should, of course, be limited to the syndrome known as Paget's disease.

A somewhat analogous affection has also been described by Marie and Astie, under the name of "cyphose heredo-traumatique."

DEFINITION. Marie has defined the essentials of his disease as the coincidence of a complete fusion of the vertebræ, with a more or less complete ankylosis of the proximal articulations of the limbs, the small articulations remaining intact. If we are to accept his idea of the identity of this condition, the definition needs no elaboration. But there are, undoubtedly, cases where the spine alone is affected, and that but to a trifling extent. A similar process may affect other bones and

joints of the body, while the spine remains free; with this, of course, we have nothing to do in this paper.

Historical Note. It is no new condition. May examined the bones from Egyptian tombs known to be at least 5500 years old, and found one skeleton presenting the deformity of rheumatoid arthritis of the hands and other joints, while the spine, particularly the cervical region, was the site of marked changes. There existed a sort of fusion of some of the vertebræ. Other mummies from the same country, but of a much later date, exhibiting similar changes, have been described by Bland Sutton. Sturge, quoting an article in Virchow's *Archiv*, relates how Virchow off on a holiday trip found, in the charnel-house of a monastery, bones three or four hundred years old, which showed changes in the vertebræ. The same author, quoting from the work on rheumatoid arthritis by Dr. Adams, says that R. W. Smith described the post-mortem changes of a case before the Dublin Pathological Society in 1849.

Leyden quotes several cases, one described by Todd, where the disease was rheumatism, in which the entire spine was affected, together with all the other joints. He also mentions a case of Eulenberg's, in a girl of twelve years.

Lawrence, quoting Sandifort, states that there are in the museum at Leyden specimens showing ankylosis of the cervical vertebræ. Davies Colley mentions a specimen in the museum of Guy's Hospital. He suggests, as the cause of such changes, either rheumatism or gonorrhœa.

Clutton gives the history of a case where the spine and proximal joints were affected, and also some of the smaller joints. There was a history of rheumatism. Fagge gives a very graphic account of a case of ankylosis of the spine, and describes the post-mortem findings. He called it a syntosis of the ribs and vertebræ.

The examples from the older writers, and the modern ones as well, might be multiplied, but would only show what I have already done, that the condition was described years ago. Bricon, I might add, has called attention to a similar affection in cats. In those animals affected there was complete fusion of the vertebræ. Sutton has described the disease in horses and oxen.

Etiology. There have been many ideas advanced as to the cause of the disease. Beneke has expressed the idea that rapid changes from heat to cold and *vice versa* play an important part in the causation. Blacksmiths, firemen, and the like are, however, subjected to such conditions and they do not seem to be more prone to the disease than others. Hoffmann reports a case in a man who had a severe acne of his back. On curing his acne the spinal symptoms recovered. He concluded that the cases were largely dependent upon a toxic basis.

Leri found that the phosphates and urates were diminished in the urine, and concluded that the disease is of obscure metabolic origin.

FIG. 1.

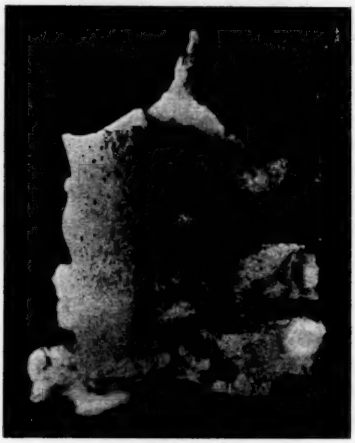


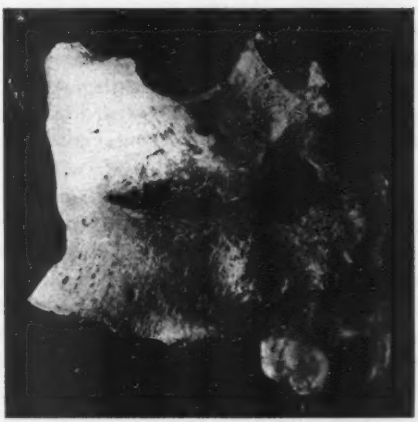
FIG. 2.

Specimens of spondylitis deformans. From the Museum of the College of Physicians and Surgeons, Baltimore. Photographs by Mr. A. S. Murray.

The infectious diseases come in for their share of the blame. Marie, Raymond, Bäumler, and others think that gonorrhœa plays an impor-

FIG. 3.

FIG. 4.



Specimens of spondylitis deformans. From the Museum of the College of Physicians and Surgeons, Baltimore. Photographs by Mr. A. S. Murray.

tant rôle; Hoffa reckons influenza as among the possible causes. Fagge reports a case where tuberculosis of the spine caused a similar ankylosis. Rheumatism has also been mentioned as a factor.

Von Bechterew would separate the cases into two classes as I have stated above, and regards the stiffness of the spine as secondary to nerve changes. Oppenheim is also an advocate of a nerve-origin theory.

Wilks lays stress on mechanical conditions and has described the lesions in laborer's spine.

As regards age, the cases are most frequently seen in young adults or middle age. Some cases have been reported in individuals of advanced age, and it has also been seen in children. Teixidor Sunol mentions a case at the age of thirteen years.

The majority of cases occur in men. Hoffa, Kirschgaesser, and others report cases in women. My own case was in a young woman.

From the above it will be seen that there are a number of causes that have been studied. The truth of the matter is very probably that any of the factors mentioned may be a cause of spondylitis. These differ very materially in their nature and will be considered more in detail later on.

PATHOLOGY. Two bone diseases may be considered. Goldthwait divides them into rheumatoid arthritis, where the inflammatory process is marked and is followed by ankylosis and atrophy of the bone, with marked deformity; and, secondly, osteoarthritis, where there are nodular deposits about the joints with no atrophy of the bones. The lesions found in the disease under consideration are the latter.

Marie very aptly described it as a fusion of the bones. Fagge graphically depicted the findings in his case in saying that the spine looked as if it had liquid bone poured upon it, and that this had been allowed to harden. Goldthwait has given admirable accounts of the post-mortem findings. The edges of the articular cartilages grow into nodules, which subsequently become ossified. The lesion extends into the ligaments that are inserted about the bone. In my case there were also nodules in the trapezius muscle that were separate from the mass about the spine, although lying directly over it. To quote Goldthwait: "With this hypertrophy at the edges of the cartilage, the centres and areas of pressure generally undergo atrophy. In the atrophy the interstitial tissue is the last to be absorbed; this, finally, does occur however, and the bones remain in apposition or become fused together. The process in the spine usually begins on one side anteriorly and extends up and down along the anterior lateral ligament. It may remain limited or it may extend to the whole spine."

The ribs are frequently involved in the process and the chest becomes immobile. In some cases there may be marked kyphosis with a consequent encroachment on the capacity of the chest. Tuberculosis may

be a secondary complication. The nodules may press on the nerves, nerve roots, or even on the cord itself. Later as the bone becomes older the symptoms of pressure on nerves or nerve roots may become better. Those from pressure on the cord itself do not improve.

Clinical History and Symptoms. The symptoms may be divided into early and into those after the disease has become fairly well marked. For the recognition of the early symptoms we are indebted to Goldthwait.

The symptom-complex is made up of four parts:

1. Pain.
2. Limitation of motion.
3. Muscular contractions.
4. Referred pains due to pressure on the nerve roots.

There are several types of pain met with in the early part of the disease.

There may be no pain in the site of the lesion, but referred pain is felt in the back, arms, or legs, according to the location of the lesion. It may be very severe and a cause of great distress.

There may be severe pain at the point where the spine is affected, and also referred pain in the back, in the anterior part of the spine, or in the back part of the abdomen.

In other cases it may suggest lumbago. It is worse after rest and improves after limbering up exercises.

Another type of pain is that referred to the anterior part of the spine, and of a very severe character. It may come on in paroxysms, and may be especially noted after periods of sleep. This type is most commonly met with when the disease affects the lumbar spine.

Referred pain is either unilateral or bilateral. When the latter, note that it is felt worse on one side than on the other. It is felt in the nerve endings, and not along the track of the nerve as in neuritis. There may be areas of hyperæsthesia and anæsthesia.

Associated with these pains there may be some limitation of motion, and this is usually worse on one side than the other.

There is no characteristic attitude in the early stages. There may be lateral curvature in the early case, and this may be more apparent on walking than on standing.

Later in the disease the symptom-complex is a striking one, so much so that Marie has insisted that it be regarded as a separate disease, not merely as a form of osteoarthritis.

The spine is as if the vertebræ had been soldered together. This may be complete, the entire vertebral column being as solid as one piece of bone, or it may be limited to some particular portion of the spine. When it is limited in extent it is most apt to be in the lower part, and involves the lumbar or the lumbar and lower dorsal vertebræ. The

cervical spine may in these cases remain unaffected for a long time. In other cases most of the ankylosis may be in the upper part of the spine.

Along with this stiffness of the spine there is a certain amount of deformity of it as well. There is a curving forward of the upper part of the back bone, and the patients usually maintain a stooping posture, which is rendered more pronounced on account of the ankylosis of the hips. The lower part of the spine remains more or less straight. The bending of the spine forward may occasionally be absent, and the patient may sit upright in what seems to be a most uncomfortably straight position. Scoliosis may also be present.

The exostoses can often be felt. This is especially true of the case where the cervical spine is involved as the nodules or bands of bone can be felt in the pharynx.

The abnormal deposits of bone may be so large as to be apparent to the most casual observer, as in the case reported where the neck felt like a large, solid mass of irregularly shaped bone.

The stiffening of the back is a slow process in most of the cases, and covers months and years, growing gradually worse and worse. The patients note the difference, especially by looking back at some previous date when they remember that they could move the spine to greater degree.

The *ankylosis* of the shoulder and hip-joints is a second marked feature of the disease. This comes on coincidently with the disease in the spine and gets gradually worse. The shoulders are affected to a lesser extent than the hips. The arm, however, in the average case cannot be raised above the horizontal, and will also be found to be limited in its motion in other directions if carefully tested. As a rule, the patient may think that his arm is perfectly good, because he has no occasion to make extensive movements. In women the change in the shoulder is noted early on account of difficulty experienced in dressing the hair, which soon becomes very difficult, if not impossible. Men whose occupation requires them to lift their hands above their heads, as clerks, notice the disease very early.

In moving the arm about and making wider movements than the patient can make for himself pain is caused, which in some cases is very severe. In many cases a rubbing or grating can be felt in the joint. The patient himself feels this, and it may be a cause of complaint. The grating may only be elicited by some particular movement, usually a forced one.

The hips are always affected to a greater extent than the shoulders. The involvement of the hip is always troublesome, interfering as it does with locomotion, station, and even sitting and the position in bed.

The patient soon gets so that walking is difficult, and then only to

be done when aided by a cane or crutches. When the ankylosis becomes pronounced the patient may be condemned either to bed or to a chair, but some of them manage to walk from the knees. This gives a most peculiar and characteristic gait. Sitting is not much interfered with in some cases, while in others, when the ankylosis is more or less complete, it may become so difficult that the patient remains bedridden. The position in bed is characteristic. If the patient lies on his back the knees are elevated in the bed, and if one attempts to straighten the legs forcibly so as to make them flat in the bed, the patient's back is raised. In the cases where there is more or less complete ankylosis of the spine, as well with the customary bowing forward of the upper part of it, the spine cannot be made to touch the bed all at once. On depressing the shoulders the sacrum is raised, and when the sacrum rests on the bed the cervical parts of the spine must be supported by pillows. The patient generally lies on the side with the legs drawn up.

In some cases the knees are slightly affected. There is limitation of motion and grating on forced movement. The patient is not at all disturbed by the knee involvement, and in many cases is ignorant of it until it is revealed by a careful examination.

Viewed from the side, the patients show a decided flattening of the chest and pelvis. In the former, evidently due to actual changes in the shape of the thorax, while in the latter it may be due to atrophy of the muscles, and possibly, also, to involvement of the bone.

There is also an atrophy of various muscles, due evidently in most cases to non-use, in some, possibly, to disturbance caused by pressure on the nerves. In some of the cases Bouchard's nodes have been described.

As the disease progresses pain usually ceases or becomes much better.

The cause of this is probably in that during the acute process there is more or less vascularization of the soft parts, and the pressure on the nerve roots greater than later, when the active stage having ceased the tissues contract, and so the pressure is removed.

The ankylosis of the spine almost invariably involves the ribs, and causes fixation of part or of all of the thorax. In the cases where there has been an extensive involvement the thorax is fixed and the breathing wholly abdominal.

Diagnosis. The diagnosis of the disease must be considered as regards the early cases and the late ones. The disease is unquestionably more common than has generally been supposed. It is not infrequent to meet with specimens in the dissecting-room of all grades of the disease. Most of the individuals have previously been under medical supervision in institutions, yet the disease rarely appears before medical societies or before classes. As Goldthwait suggests, many of the cases are passed over and treated as a "touch of rheumatism."

The early cases may be confused with beginning Pott's disease, and even some of the more advanced cases. In some it may not be possible to differentiate them until after several careful examinations made at sufficiently great intervals. The fact that the pains are greater on one side than the other is of some value. If there is paraplegia present, it may be differentiated, as the paralysis in Pott's disease is usually central, while in spondylitis it is of a peripheral type.

In his work on rheumatic gout Garrod states that there is usually some stiffness of the neck, and in 500 cases this was complained of 178 times. It is attended with some grating at movement. The presence of the other symptoms of the disease should serve to differentiate it. Nevertheless it should be borne in mind in considering pain in the spine.

Rheumatism may involve the spine. When it does, it generally is cervical, while spondylitis is usually in the lower part of the back. There are evidences of the disease in other joints, and the other symptoms. Von Leube states that according to his experience rheumatism of the spine is not a rare affection, and that it may occur without involvement of the other joints.

Pachymeningitis cervicalis hypertrophica may simulate spondylitis in the beginning. In this affection in the stage of irritation there are severe pains, stiffness of the neck, radiating pains, hyperæsthesia and anæsthesia in the arms, exanthems, herpes, and pemphigus, as well as scaling and roughness of the skin of the arms, and rarely twitching of the muscles. There may be difference of the pupil.

Pachymeningitis hemorrhagica interna is accompanied by stiffness of the neck and radiating pains. It gets better and worse, and is associated with mental and brain conditions. It usually occurs in drunkards and syphilitics and cannot, as a rule, be diagnosed.

Traumatic hereditary kyphosis (cyphose heredotraumatique) has been described by Marie and Astie. In this affection there are the etiological features of heredity and trauma. The entire spine is involved in a large curve, while the joints of the members remain unaffected. There are nerve pains, particularly of the sciatic.

Laborer's spine, the duplicature champêtre of the French, must not be confused with spondylitis. It is common in those whose occupation involves almost constant stooping. In this condition there are no exostoses, and but trifling involvement of the joints, according to Marie. Wilks, as stated before, described osteoarthritis as laborer's spine.

Gonorrhœa involving the spine should also be considered, not only as a possible etiological factor, but in view of the fact that it has been described as involving the spinal articulations. Nolen mentions two cases. One recovered, and one passed out of sight. Other joints are apt to be affected. It is evidently of extreme rarity. Out of 119 cases of gonorrhœal rheumatism cited in the *Dictionnaire de Médecine et*

*Chirurgie* (quoted by Bradford and Lovett) the spine is not mentioned at all.

Von Bechterew's symptom-complex is based on his own cases. It consists of:

1. A greater or less immobility of the entire spine or a part of it, with no marked pain on pressure or percussion.

2. A backward bowing of the spine, especially of the chest region, causing the head to be thrown forward and the chin depressed.

3. A weakened condition of the muscles of the rump, neck, and extremities, often with a trifling atrophy of the back and shoulder-blade muscles.

4. A lowering of sensibility, particularly of the skin branches of the dorsal and cervical nerves, and sometimes of the lumbar nerves.

5. Various irritation phenomena, as paræsthesia, pain in the back and neck regions, especially in the cases of long standing.

Von Bechterew has described cases of spondylitis as well as cases of the above syndrome, and insists on the identity of his disease, regarding it as one of nervous origin. There is an ascending degeneration of the cord in these cases and there are no exostoses.

In passing it might be said that Folli has described an atrophy of the anterior cornua in a case of spondylitis. The cord has not been studied in many cases of spondylitis.

It must be borne in mind that stiffness of the spine is a symptom of no inconsiderable moment in many conditions, especially those of nervous origin, although it is a much neglected one.

The diagnosis is, as a rule, easy, but it might be well to mention the conditions in which it occurs.

According to Bäumlein it is a constant feature of hereditary ataxia, and he places the cause of it in this condition, as do Hallion and Friedreich, as an insufficient musculature.

In syringomyelia it is also a feature of moment; indeed, there is considerable danger of mistaking some cases of syringomyelia for spondylitis, if the former disease is not borne in mind. The stiffness of the spine, with limited active and passive motion, may be misinterpreted by a careless observer. Roth states the cause here is due to changes in the muscle, but Schlesinger, Brühl, and Hallion regard it as due to trophic changes in the bones. Nalbandoff has recently ascribed the changes to the same causes, after careful study.

Kyphoscoliosis is seen, too, in infantile hemiplegias and diplegias (Oppenheim), in the acute infantile anterior poliomyelitis, in amyotrophic lateral sclerosis; in tabes it may be seen as a spinal arthropathy; Charcot subsequently, in 1886, called attention to the same deformity in sciatica; in the interstitial hypertrophic neuritis of Sottas and Dejerine, scoliosis is constant.

Duchenne has called attention to an hysterical scoliosis, but Albert, of Vienna, states that it is of very rare occurrence.

The stiffness of the spine in paralysis agitans must not be forgotten.

Lastly, Oppenheim gives it as a neuropathic tare, which coincides with the experience of most physicians.

PROGNOSIS. With an early diagnosis and proper treatment the prognosis, according to Goldthwait, is better than formerly supposed. Much of the deformity can be prevented. Otherwise the prognosis must always be guarded. The danger to life itself is trifling. No deaths from the disease have ever been reported. It may be indirectly the cause of death in that those patients with ankylosis of the ribs may contract tuberculosis owing to the deformity and immobility of the chest.

Pressure on the nerves may cause pain which is difficult to relieve.

The disease may progress slowly and produce a great amount of deformity or it may stop short at any time. In many cases the disease is not recognized during life, but is revealed at the post-mortem or may be found in the dissecting-room.

In many cases the disease undoubtedly causes but little disturbance. In others it may produce total disability. There is at present no way to tell which case will do well, and which badly.

TREATMENT. The general condition should receive attention. All of the smaller ailments of the patient should, if possible, be cured. All sources of possible absorption of toxic material should be removed. The skin should receive careful attention, and warm baths and massage may be used for this purpose, as well as to aid in the general building up of the patient. Electricity will also be found useful.

The tendency to constipation should be corrected. Phosphate of soda and similar drugs are of value in this connection.

Good, nutritious food, plenty of fresh air, together with such tonics as iron, cod liver oil, arsenic, strychnine, and alcohol, as may be suited to the case, are to be advised.

Individuals with a rheumatic tendency may be given salol or the salicylates, but long courses of treatment with these or other drugs which tend to deplete the system or to cause anæmia are to be avoided.

In the early cases much can be done, according to Goldthwait, to relieve the symptoms and to prevent the deformity. He recommends the use of mechanical support to the spine either by the use of plaster casts or of special apparatus. He claims to have gotten excellent results by these means. The support is to be kept until the disease is entirely quiescent.

Bäumler obtained good results in one case by placing the patient in bed on his back. This same end may more easily be accomplished with the use of supports to the spine.

Local warmth is especially agreeable to these patients, and a thick layer of cotton may be applied next to the skin.

In the older cases where the disease has already caused deformity the results of treatment are on the whole not very satisfactory.

Forced movements, extension or suspension, are not to be used, as they bring a strain on a diseased part, and consequently do more harm than good.

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## A CASE OF OSTEITIS DEFORMANS, WITH HEART COMPLICATION.

BY CHARLES J. FOOTE, M.D.,
OF NEW HAVEN, CONN.

THE following case of osteitis deformans is reported because of its unusual visceral complications:

B. W. P., aged fifty-two years, bachelor, American; oysterman. Entered the New Haven Hospital February 11, 1893.

Mother died of consumption at fifty-seven years of age; father died at eighty-five years of age. No record of brothers and sisters.

*Previous History.* Patient had scarlet fever in childhood, and there has been some deafness with more or less discharge from the ears ever since. With this exception he has been well, and gives no history of rheumatism, gout, syphilis, or other disease. About twenty years ago he was much addicted to the use of alcohol, but for the past nine years has been quite temperate. He gives a history of trouble with his legs in 1885, resulting in ulcers which did not heal for some years. In January of 1893 patient began to be troubled with severe dyspnœa and was confined to his bed. He entered the hospital February 11, 1893. At that time the following record was made of his condition: Veins of neck and forehead excessively distended and pulsating. Face and hands cyanosed and cold; considerable œdema of legs and some ascites; legs below knees are enormously swollen, discolored, and covered with a thick, dry skin resembling that of elephantiasis; one small ulcer yet unhealed on shin-bone.

*Examination of Lungs.* Negative.

*Heart.* Apex-beat in fifth interspace inside nipple line. The beats are rapid, irregular, and tumultuous. The area of heart dulness somewhat increased. There is a very marked murmur preceding and taking the place of the first sound, heard loudest at apex, but also to a less degree in the aortic and pulmonic interspaces. There is a great venous engorgement; a bruit may be heard over a large, pulsating, venous tumor over right sternoclavicular articulation. Heart sounds may be heard all over the neck and chest. Liver dulness begins above at the sixth interspace and extends just below the free border of the ribs in the nipple line. Liver easily felt on palpation.

*Spleen* not apparently enlarged.

*Urine.* Specific gravity 1020; amount varies from 800 to 1000 c.c.; a trace of albumin, no casts.

I first saw the patient on August 20, 1893. At that time the heart was considerably enlarged. The left line of dulness was fully one inch outside the nipple line. The apex-beat was in the fourth interspace just outside the nipple line. Systolic murmur at apex transmitted to the axilla; second pulmonic sound much accentuated, with slight reduplication over pulmonic area.

Liver extends one inch beyond border of the ribs in the parasternal line. There was considerable ascites.

From this time to July, 1895, the patient was tapped frequently, at times every six weeks; at each tapping from three to five gallons of serous fluid were removed. After July, 1895, there was no ascites to the time of death, November 26, 1898, and the abdominal walls were lax and sunken.

For the last three years of the patient's life, therefore, there was an excellent opportunity to palpate the abdomen. The spleen, liver, and kidneys could be easily felt and manipulated. The lower border of the liver, in fact, could easily be seen ascending and descending with respiration. During the last three years of the patient's illness there was a gradual increase in the size of the liver. The year of his death it extended two inches below the border of the ribs in the nipple line, and the outline of the lower border could be plainly seen. The liver was not especially tender; it was smooth and not nouldar; there was no very marked enlargement of the veins of the abdominal walls. On palpation the liver was felt to pulsate; the pulsation was systolic in tone and may have been due to the transmission of the ventricular impulse of the enlarged heart. There was no history of jaundice.

*The Spleen.* The enlargement of this organ was discovered in 1896. As in the liver, there was a gradual enlargement. The year of the patient's death it extended about one inch below the border of the ribs and could be easily palpated.

The heart gradually enlarged each year. The year of his death the left line dulness was one and one-half inches outside the nipple. A systolic murmur was heard loudest over the second left interspace, apparently the same murmur, but much weaker, heard over the second right interspace. As we went down toward the apex it grew weaker and was heard very faintly at the apex.

Patient died November 26, 1898, five years after entrance into the hospital, at the age of fifty-seven years. No autopsy.

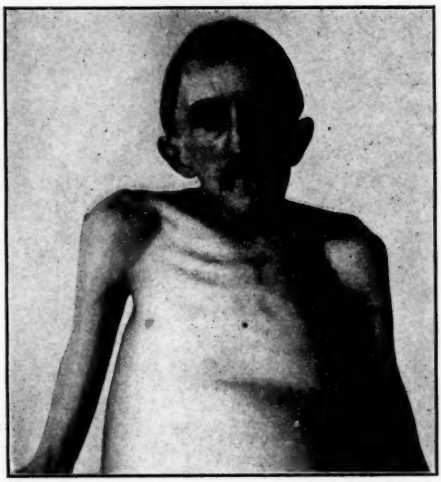
When examining the patient I was frequently impressed with the size of his head and the massiveness of his tibiæ. This led me to a

diagnosis of osteitis deformans, and to make a more careful study of the bones.

The head was large, as a whole, the enlargement involving mostly the calvarium, while the face was rather small.

The face had a triangular shape, with pointed chin and rather broad forehead. The circumference of the head at the line of the hat band was 25½ inches. Patient said his head had grown large during the last twenty years; he used to wear a 7¼ hat, but now wears an 8⅛. The surface of calvarium is irregular. On each side of the sagittal suture there is a very pronounced depression in each parietal bone measuring 5 x 6 cm., giving the impression of a collapse of the skull.

FIG. 1.



The angle of the jaw is very oblique, in fact, almost obliterated, so that it seems like a straight line from condyles to the chin. The mastoid processes are very prominent.

There are only a few teeth left in the upper and lower jaws. The gums are much retracted from the teeth that are present, and the teeth are loose and decayed. The maxillary process on both the upper and lower jaws seems atrophied. The zygomatic processes are not especially prominent.

The spine shows a very marked kyphosis in the dorsal region. The seventh cervical vertebra is very prominent, but none of the other vertebræ are. There is no lordosis. The dorsal curvature produces a decided shortening of the stature. The head is characteristically projected forward, as shown in the photograph. (Fig. 2.)

The chest is decidedly barrel-shaped; the anteroposterior diameter being as long, if not longer, than the transverse diameter.

The shape of the chest is well shown in the photograph, lateral view. It bulges much behind in the upper dorsal region. In front there is a decided depression in the sternum just below the articulation of the clavicles; below this point there is a bulging forward of the chest.

FIG. 2.

FIG. 3.

The ribs are very prominent and rather massive in the axillary regions; the seventh rib especially seems much enlarged, so as almost to obliterate the intercostal spaces at this point.

The clavicles are very large and prominent, especially at the acromial ends.

There is a certain amount of eversion or spreading of the borders of

the ribs above the right and left hypochondria, which is characteristic of the disease; but in this case was quite likely caused by the enlargement of the liver and the ascites.

Examination of the upper extremities shows some enlargement of the spines of the scapulæ, especially at the acromial ends. The humerus seems normal. There is a decided bowing outward of the radius on each side, with a marked prominence of the styloid processes of the ulnæ.

The bones of the hands are not enlarged.

The pelvis is broad; the distance between the crests of the ilia is 34 cm.; the conjugate is 21 cm. No local irregularities noted about the femora or patellæ, but there is a decided bowing outward of the femora.

The tibiæ are very large; in fact, these were what first suggested the diagnosis of osteitis deformans to me. The tuberosities especially seem much enlarged.

When the patient is standing erect, with heels together, he cannot approximate his patellæ within 30 cm. of each other.

The feet show no bony enlargements.

This case is interesting not only on account of the bone lesions, but on account of the affection of the liver, heart, and spleen. In osteitis deformans these organs are not necessarily affected; in fact, the viscera are usually normal.

The patient entered the hospital for dyspnœa and cough. Diuretin was given him and it seemed very efficient in relieving his ascites and œdema and increasing the amount of urine.

During the last three years of the patient's life he was quite comfortable most of the time, and was up and around the ward in a wheel chair nearly every day. He had a fair appetite and suffered little pain anywhere, though at times he had diarrhœa lasting for a few days. He was extremely weak on his legs and walked but little. He died more as a result of the heart lesion and its sequelæ than of osteitis deformans. There was no evidence of sarcoma in any part of the body.

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## A CASE OF ANEURISM OF THE INNOMINATE ARTERY; LIGATION OF THE RIGHT COMMON CAROTID AND SUBCLAVIAN ARTERIES, FOLLOWED BY SECONDARY HEMORRHAGE AND DEATH.

By John G. Sheldon, M.D.,

SURGEON IN CHARGE OF THE MINERS' UNION HOSPITAL, TELLURIDE, COLORADO.

John J., aged forty-one years, laborer, came to me in November, 1902, complaining of a pulsating growth on the right side of the neck, pain in the right side of the chest, right shoulder, and right arm, and severe headaches. He knew of no cause for his trouble. He had been well until six months previous to seeing me. At that time he accidentally noticed the tumor, which had progressively increased in size.

The patient denied having had syphilis. Had used alcohol and tobacco moderately. His father died of apoplexy at the age of fifty-seven years.

Examination revealed a pulsating tumor behind the right sterno-clavicular articulation, which extended one inch above the clavicle. Dilated veins were present over the anterior surface of the chest and neck. The region corresponding to the location of the innominate artery was more prominent than was the corresponding area on the left side, but no pulsation of the thorax could be detected. Palpation revealed a thrill over the innominate artery. A bruit could be heard distinctly. The radial and carotid pulses were slightly retarded on the right side. The radial arteries were tortuous and hardened. The pulse was full and the arterial pressure high. The heart was slightly enlarged to the left, and was beating regularly eighty times a minute.

A diagnosis of aneurism of the innominate artery was made. Ligation of the right common carotid and subclavian arteries, followed by filipuncture and electrolysis of the aneurism and the administration of potassium iodide internally, was advised.

The patient was anæsthetized with chloroform, and two catgut ligatures placed on the common carotid about one inch above the aneurism. A single catgut ligature was placed on the third portion of the right subclavian artery. After the operation the arm was kept moistened with warm saline solution. The entire right upper extremity became painful and helpless, but the circulation was sufficient to retain its vitality. The pulsation in the tumor was not affected by the operation.

On account of the severe pain the patient desired that further operative procedures be delayed for a few days. His request was granted. On the third day following the operation eight ounces of a 2 per cent. solution of gelatin were injected into the left axilla. This produced no noticeable effect. On the fifth night following the operation the wound over the carotid opened and bled freely for a few minutes. A compress stopped the bleeding. During the next day four hemorrhages occurred. The following night the patient had nine hemorrhages; some of them were severe.

The patient was becoming weak, and a ligation of the innominate was decided upon as a last resort. During anæsthetization the patient coughed once violently. Immediately a large quantity of blood escaped from the incision over the carotid. The wound was packed firmly, but the patient became pulseless and died.

Post-mortem examination showed a fusiform aneurism of the innominate artery three inches in its transverse diameter. The rupture had occurred at the upper and posterior part, filling the mediastinum and surrounding structures with blood. A complete autopsy was not made.

When this case came to me I was undecided as to the course of treatment to advise, and I am still at sea on the matter.

The results from ligation of the innominate are such that the operation is an undesirable one. Ligation of the internal carotid and subclavian does not give encouraging results. A case similar to the one herewith described was reported from Braun's clinic at Königsberg. The patient showed no improvement after ligation of the carotid and subclavian, and died fifty-one days after being operated upon. H. Jacobsthal (*Centralblatt für Chirurgie*, August 23, 1902) believes that peripheral ligation is more likely to increase the blood pressure than

to lower the pressure or slow the stream. He states that the results recorded do not support ligation. He found no improvement in any of his cases treated by this method. In 1893 Pivot reported ninety-three cases in which peripheral ligation was done, with 7.4 per cent. of cures. Jacobsthal reported thirty-three cases treated by Macewen's needling, potassium iodide, filipuncture, and subcutaneous injections of gelatin. Fifteen of these cases were improved. One lived three and one-half years, death resulting from cerebral softening. The autopsy showed the aneurism completely thrombosed.

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## AN IMPROVED FORM OF STETHOSCOPE.

By Henry E. Wetherill, M.D.,
of Philadelphia.

This instrument does better what other stethoscopes do, and in addition has other functions not common with instruments of its class. With it you can auscultate two parts at once, and get an intimate comparison of the sounds. The comparison of the vocal fremiti from different locations can be delicately made.

A more intimate comparison of sounds can be had than is ordinarily obtained, by first listening to one sound and then to another. A little practice enables one to differentiate two sounds occurring at the same time.

One-eighth size.

One of the bells.

As slipped together.

When one sound is made a little before another their comparison is more intimate than when a considerable time elapses between the making of one sound and the making of another. Thus, when the little taps are made on the projections of the bells, the sounds coming from the part percussed are intimately differentiated. Slight asynchronism of sounds is detectable, as where there may be a difference in time of closure of cardiac valves. Transmitted murmurs can be timed with valve closures. Where a closer isolation of a valve sound is wanted, one of the bells is used and gives plenty of sound, and is so constructed that it will fit well in spaces, as between the ribs.

Percussion can be made with but one bell or with both. For superficial auscultation the rubbing of the finger over the slightly roughened end of the flexible projection will give a note depending upon the dulness or resonance of the body underneath. The very soft copper projections are positioned so that the thickening at their extremities will come under the second fingers, and their flexibility enables one to adjust the metal to the part so there will be no air space or false motion, and a good note will be produced. The fingers striking the projections equally enable us to compare the notes that are transmitted by the tubes to the ears. Separated from the tubes, the bells can be used as single or double pleximeters. The fingers act as plexors.

Auscultatory percussion can be done with one bell and tube, or with both, or one or the other bell may be used for auscultation or percussion in auscultatory percussion.

The instrument is good where one little sound is to be compared with another. The larger sounds are easier to compare.

The increase of vocal fremitus at the right apex is very nicely shown by placing one bell on either apex, and having the patient say, "one, two, three," or "hum-m-m."

Immediately the greater succussion and noise will be feebly heard in the ear connected with the part giving the greatest vocal fremitus. In this way the instrument is useful in detecting the first stages of phthisis pulmonalis. This is one of the best points about this instrument, and renders it of incalculable value as an aid to early diagnosis when the physical signs are obscure.

If there is a difference in one's ears it can be allowed for by testing, as by listening to the sound of a clock, using both bells. In practice the changing of the position of the bells will serve to eliminate this objection.

The comparison of remote parts can be made, and even one person can be compared with another.

Where one bell is used the oval lumen of the other similarly shaped bell may be closed with the thumb, which fits it, or the trouble with extraneous sounds may be entirely avoided by having the room quiet.

The parabolical shape of the bells, the nature of the metal, the large sizes of the tubes, and the general ensemble of the apparatus is conductive of clear sharp notes of considerable loudness, which compare to advantage with various forms of phonendoscopes.

A diaphragm may be put on the end of the bells, but it is not necessary, and the greater simplicity of the apparatus is an advantage. It will stand rough usage.

The projections can be repeatedly bent near to the sides of the bells when they are not being used.

The hinging of the springs holding the ivory-capped metal tubes in

the ears helps their adjustment to the lumen of the auditory canals, as well as making the folded instrument compact for the pocket.

The beating of the heart can be heard through the clothing, and the bells can be slipped under the collar and clothing.

The bevel dovetail joint fastening the two bells is held firmly together by the binding of the metal and the rubber, so there are no extraneous sounds from false motion between the bells. Thus joined a single stethoscope is made.

In locating the limiting line of an area of dulness, resonance, etc., the bells can be moved past each other, and when the sounds reverse in the ears the opposite condition is under the bell used. When the sounds are the same in both ears the conditions are similar. The bells can be moved about to localize such areas of dulness as are present in catarrhal pneumonia; and in the same way one lobe of the lung can be outlined when it is pneumonic.

Areas of dulness can be compared with one another, and the bronchial breathing on one side can be compared with normal respiration on the other.

In using one bell as a pleximeter it is grasped with the thumb and first finger, and the second finger is used to strike the thick end of the projection, thus acting as the plexor. Thus, but one hand is used where we formerly used two, and the blow has good quality and can ordinarily be struck with sufficient force, particularly when the tubes are attached. The bell can be held in one hand and the end of the projection struck with the second finger of the other hand when a wrist or arm force is desired. Very little practice is required to be able to strike similarly with either second finger. One can use this method of percussion in awkward positions, and a very sick patient need not be disturbed; and where a spot is tender light percussion with the aid of the auditory attachment will bring the condition to the ear without unnecessary pain caused by a heavier percussion.

Percussing with both bells is like using four hands, for ordinarily we use two for one percussion. Doing as above enables us to intimately compare two sounds, and, in case we are a little unfamiliar in separating two sounds struck at the same time, one percussion can be made a little before the other, and in this way a close comparison of one with the other can be made. As pleximeters one bell may be used in either hand independent of the detachable tubes.

It is more a comparison of two sounds that we want in medicine than it is to have a comparison with sound standards, which are difficult to get.

Where we tapped and listened, and then tapped the other place and listened, and then compared the dying-out sound with the mental picture of the first sound made, there was room for a considerable personal

equation. Doubting ourselves many times, or forgetting the first sound, we have returned to make the first sound again and again. This is obviated by the present instrument.

In making this stethoscope it is believed that new matter of value has been added in this line, as the acoustics of the subject have been considered; and where new functions are added to the stethoscope they seem to be of advantage, as shown by the trials of the instrument by quite a number of my colleagues. The instrument has been improved upon repeatedly during the considerable length of time in which it has been tested.

For want of a better name, I call it a "Double, or Differential Stethoscope."

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## THE FERMENTATION THEORY OF INFECTION AND IMMUNITY.

By J. W. McLaughlin, M.D.,
PROFESSOR OF MEDICINE, SCHOOL OF MEDICINE, UNIVERSITY OF TEXAS.

In 1828, when Wöhler synthetized urea, modern physiological chemistry was born, and at the same time it was demonstrated beyond a peradventure that the peculiarities of organic substances are the result solely of the properties of carbon, their chief constituent. From that day until this it has been more and more clearly demonstrated that the so-called vital processes are but highly specialized chemical and physical phenomena such as are daily encountered in our laboratories. The recent work of Loeb, which carries into the realm of physiology the work of Van Hoff, Arrhenius, and others, is a gigantic stride in the demonstration initiated by Wöhler. That the phenomena of fermentation and of infection and immunity are strictly analogous processes and that these analogies point unerringly to a common causation has been recognized for more than three hundred years; yet the common cause has heretofore remained a mystery. It is the purpose of this essay to present an explanation of those phenomena based upon accepted theories of molecular structure and molecular energy.[1]

Fermentation, broadly speaking, is a chemical or chemicophysical change induced in certain substances by specific bodies themselves unchanged and resulting in specific products. These change-inducing

[1] The principles of molecular physics involved in the explanation of fermentation by the author were utilized by him as far back as the 80's to explain the mysterious action of medicines on the living organism; and in 1890, in an abstract of a paper on fermentation, immunity, and infection, read at the annual meeting of the American Medical Association, these same principles were held to underlie the phenomena of these processes. In 1892 this subject was more fully elaborated in a small volume, which was published by the author, entitled "Fermentation, Infection, and Immunity."

bodies may be divided into (*a*) living ferments and (*b*) non-living enzymes. In a narrower sense the term "fermentation" is applied merely to changes induced by living ferments; while the term zymolysis or zymosis is reserved for that produced by enzymes. Living ferments are micro-organisms, which are widely distributed in nature, including many bacteria, blastomycetes, and some moulds. Enzymes or non-living ferments are bodies which are formed within living cells of animals or plants of the higher order of life. The two classes of ferments present many points of similarity in their action; for example, both classes work best at practically the same temperature, about that of the normal human body; both are destroyed by boiling; either will cause insoluble substances to be transformed so that they pass into solution; each is hindered and may be arrested in its action by the products of its own activity; neither adds anything from its own substance to the ferment products; and each manifests selectivity, in that a definite structural relation must exist between the ferment and the fermentable substances, in order that fermentation or zymolysis may take place. "We know[1] that properties which are supposedly characteristic of the enzymes are possessed also by certain elements which are found only in the inorganic world. The most notable property of the enzymes is their ability to effect an amount of change which is out of all proportion to the quantity of the enzyme present, and the fact that the enzyme itself apparently does not enter into the reaction. These properties, however, are common to certain metals and their oxides. Bredding and von Bermaik showed that a gram-atomic weight (193 grams) of colloidal platinum diffused through 70,000,000 litres of water shows a perceptible reaction, or more than 1,000,000 times the quantity of hydrogen peroxide; and H. C. Jones demonstrated that the reduction that here takes place is a monomolecular reaction. Curiously enough, the analogy between the action of such metallic solutions and that of the enzyme goes farther. Finely divided platinum, palladium, iridium, osmium, etc., thus have the power of inverting cane-sugar, like one of the enzymes—invertase; and certain poisons, such as hydrocyanic acid, sulphuretted hydrogen, carbon disulphide, and mercuric chloride, which inhibit or even suspend the action of the enzymes entirely, exert a similar influence upon the solution of colloidal platinum."

It was shown by Pasteur, and later confirmed and more fully worked out by Hansen, that a pure culture of ferment micro-organism is necessary in order to secure purity in saccharifierous fermentations. The quality of beer, for example, has been greatly improved by methods in securing pure cultures of the required ferment. More recently Emil Fischer has, by purely chemical research resulting in his cele-

[1] Simon. Physiological Chemistry.

brated work on the synthesis of sugars, on the use of phenylhydrazin, and on the ozone reaction, diverted the current of views on fermentation phenomena into new channels. His researches led him to explain the behavior of yeast toward the particular sugar of the nutritive liquid in the same way as the action of the enzyme (invertase, emulsin), so that the chemical activity of the living cell does not differ from the action of chemical ferments. According to Fischer, the fermentation of polysaccharides is always preceded by the hydrolysis of sugar. *But there exists an exact relation between the molecular structure of a given sugar and the sugar-inverting enzyme of the yeast cell; if the sugar comes into contact with the albuminoids of the yeast cell, which play the most important part among the agents of which the living cell makes use, the sugar is decomposed only if the configuration, the geometrical structure of its molecules, does not deviate too much from the configuration of the molecules of the albuminoids.*

Furthermore, Buchner has recently shown that the juice obtained from yeast cells by hydraulic pressure is capable of quickly fermenting highly concentrated sugar solutions of various kinds, even after it has passed through a Berkefeld filter. He infers from his experience that the fermentative power of the expressed juice is embodied in a soluble enzyme-like substance isolated from the living cell plasma.

However, it has been demonstrated repeatedly by independent observers that a vessel filled with unfiltered grape-juice and divided into two parts by a thin layer of cotton-wool shows active fermentation only in that portion into which yeast cells are introduced. Since such a partition is incapable of prohibiting the free passage of soluble enzymes, we must conclude that the direct contact of the yeast with the fermentable substance is necessary. In other words, it has been shown that the active cause of fermentation is a substance which is not normally thrown off by the cells, but which may be extracted from them by destroying the inherent properties of the cells, including their vitality. That the function of vitality is not identical with that of fermentation is proved by the facts of attenuation already mentioned. I conclude, therefore, that the active ferment is not a secretion of the ferment micro-organism, but is an inherent property of the cell, which may be destroyed, but not extracted without destroying the vitality of the micro-organism.

It may be well to keep in mind the fact that the products of fermentation inhibit the activities from which they result. Alcohol, for example, inhibits vinous fermentation, when its accumulation in the solution has reached a definite combination. When this equilibrium is reached *the sugar is immune to the activities of the yeast cell, and alcohol is the immunizing agent.* This is not a phenomenon characterizing vinous fermentation alone, but is, on the contrary, common to all fer-

mentations. Nor is it a chemical combination between the factors involved, but must be a physical equilibrium (if I may use the term), because of the fact that the removal of a portion of the alcohol results in fermentation again, becoming active until the requisite percentage of alcohol has again accumulated.

INFECTION AND IMMUNITY. Infection may be defined as that condition of the body resulting from the entrance and the multiplication of micro-organisms which cause to be produced organic poisons whose effects upon the organism are the symptoms of disease. The introduction of pathogenic products alone may cause symptoms and lesions of infection, but the resulting condition in this case is not communicable, as the presence of living pathogenic microbes is necessary to the possession of this latter quality.

The following characteristics are possessed in common by pathogenic and ferment micro-organisms: (1) They are specific in their activities. (2) The power possessed by ferment micro-organisms to produce specific ferment products is manifested by pathogenic micro-organisms as a power to produce specific pathogenic products; but the results obtained with either species of micro-organism, ferment or pathogenic, will vary with the environmental conditions of heat, soil, light, etc., under which the micro-organisms are placed. (3) With both species the capacity of the micro-organism to do specific work, as fermentation in the one instance and pathogenesis in the other, may be modified, lessened, or increased temporarily or permanently, without visibly changing the vital characteristics of the micro-organism whereby it lives, grows, assimilates, and propagates. (4) It has been shown that the function of cell vitality of both species of micro-organisms is not identical with the capacity of the cell to do specific work—ferment or pathogenic—and that the latter function is an inherent property which can be variously modified or destroyed by natural or by artificial means, but which cannot be extracted without destroying the vitality of the cell. (5) The products of cell activities—ferment and pathogenic—are inhibitory substances, antibodies, which tend by accumulation to arrest the processes of which they themselves are the results.

Immunity of an organism to infection may be an acquired or a congenital condition. Once acquired immunity may be partial or complete, temporary or permanent. The means of defense against infection which an organism acquires is not the same in all cases. In one form of acquired immunity the organism is capable of neutralizing the toxins, antitoxic immunity. In another form of immunity the organism is able to destroy the invading bacteria, antibiotic immunity. In another form of acquired immunity the protection enjoyed by the organism is due to conditions which prevent the production of toxins in its tissues by a species of pathogenic bacterium. This form I will call

somatic immunity. But since immunity of the organism, whether this be congenital or acquired, partial or complete, transient or permanent, antitoxic, antibiotic, or somatic, is an ability of the organism to resist infection, we should not lose sight of the important fact that there is a necessary and intimate causative relation between the bodily condition of the organism which predisposes to infection and that condition which resists infection, and, further, that an explanation of one of these conditions will serve to also explain the other condition.

Maxwell says: "Molecules (atoms) exist of various kinds, having their various periods of vibration either identical or so nearly identical that our spectroscopes cannot distinguish them. The same kind of molecule (atom), say that of hydrogen, has the same set of vibrations whether we procure the hydrogen from water, from coal, or from meteoric iron." In other words, physical science teaches that atoms are not only in constant motion, but also that such motion characterizes the atom moving; as, for example, all hydrogen atoms have the same sort of motion, likewise oxygen atoms, nitrogen atoms, etc.; each kind has its own definite vibration period. Lord Kelvin's vortex hypothesis not only attributes to each kind of atoms its distinctive motion, but also hypothecates that the motion of the atom is the sole character which distinguishes it from other kinds of atoms.

To explain the phenomena of the universe we must recognize the presence of a continuous universal medium that pervades all space—the luminiferous ether. This medium which serves to connect all bodies, such as molecules and atoms, also receives and transmits their motion through space as ether waves; spectrum analysis is based upon this physical law.

We furthermore learn from physics that ether-wave motions, like water and sound waves, are subject to the beautiful law discovered by Dr. Thomas Young, the author of the undulating theory of light, called the "law of wave interference." Sir John Herschel says: "This principle regarded as a physical law has hardly its equal in beauty, simplicity, and extent of application in the whole circle of science."

When two sets of water waves whose troughs and crests correspond in time of recurrence meet, their amplitude will be increased—the dimension of the resulting waves will be enlarged; *vice versa*, when the periods of wave recurrence do not correspond, but the troughs of one set correspond with the crests of the other set, the resulting waves will be quenched, destroyed. Similarly, waves of sound and waves of sunlight will be intensified, quenched, or modified in various ways by other sound or light waves, according to the amount of interference that exists. This is a simple if crude illustration of the law of interference, and serves to illustrate how atomic and molecular ether waves may be influenced by the same agency.

When considered in the light shed upon the subject by the fermentation theory the term molecular structure ceases to be a meaningless name, the source and nature of cell energy becomes more intelligible, and the yeast cell no longer appears a structureless mass of enclosed protoplasm, but a machine of great complexity and capacity; we mentally behold a countless number of atoms in orderly arrangement within the molecules of the cell, vibrating in time and periods that are distinctive and imparting their own motions to the surrounding ether within the molecules. We further mentally behold a wondrous conflict of the atomic ether waves produced within the molecules which, in harmony with the law of interference, finally results in an adjustment of the conflicting waves, and in the production of a set of ether waves specific in character and which represent the molecular structure of the cell.

The adjusted waves are the resultant of the following factors: (1) The kinds of atoms comprising the molecule; (2) the particular manner in which the atoms are grouped, constituting molecular structure; and (3) interference of atomic ether waves. The set of ether waves resulting from an adjustment by interference of the atomic waves we will call molecular ether waves, and as they represent molecular structures they will, consequently, vary in their distinctive characters with variations in the structure of molecules. Ether waves possess energy, hence molecular ether waves represent molecular energy, which necessarily varies in character with variations in molecular structure.

The energy of a cell, say an yeast cell, will then be the sum of the energy of its contained molecules, provided the molecules are the same in structure. Excluding from our calculation the cell molecular groups that are directly concerned in the vegetative operations of the cell, it will be more accurate to say that the energy of an yeast cell is the sum of energy possessed by its molecular groups which are concerned in bringing about fermentation. It necessarily follows as a corollary of these principles that the distinctive energy possessed by cells of various kinds, as bacteria and ferment cells, is a result in each case of distinctive molecular structure of the cell.

It should be noted that the distinctive or special energy of a cell, or of an enzyme, as pointed out by Emil Fischer, is manifested as a capacity to produce certain changes in those substances only which bear a definite relation in molecular structure to that of the ferment or enzyme concerned.

Now, the exact relation in molecular structure of the ferment and the substance which Fischer describes as "configuration" and "geometrical structure" of the molecules, is, I hold, a similarity in molecular structure of the two bodies, and, therefore, a similarity in molecular waves and energy. In other words, the molecular waves of

the sugar and yeast cell (or enzyme) bear a definite relation in time and periods of recurrence, so that the waves of the two sets, when they meet, are intensified and the energy of the resulting waves is increased, possibly doubled. Under this wave influence the substance which is the least stable in chemical bonds—the sugar—is disrupted. The ether waves falling millions of times per second upon the sugar molecules, which vibrate in accord with the disrupting waves, are dissociated by the wave energy of the yeast.

Atoms which have just been freed from their chemical bonds, as in this instance, cannot long remain in a nascent condition; chemistry teaches that they must immediately recombine into other simpler substances. This is the condition of the sugar atoms—they have been driven from their combination and must recombine according to chemical law. We must keep in mind the fact, however, that in entering into new combinations the atoms are seriously handicapped as they must recombine against the energy of the ether waves that dissociated the sugar. It seems evident that no substance whose molecular structure is identical or too nearly identical with that of the particular sugar dissociated can form under the bombarding energy of the waves, as the energy which is capable of dissociating is also capable of preventing combinations of such substances.

Among the various substances into which the dissociated atoms may combine only those whose molecular waves are not in accord with molecular waves of the yeast are possible under this influence. It will be noted that a substance which is not in accord with yeast is not in accord with the wave energy of sugar, and it will oppose both. The substance is an antibody to vinous fermentation.

We have spoken of "accord" and "discord" or "dissonance" of ether waves to express certain relative phases of the waves. Waves that are in accord recur in the same periods of time; their troughs and crests correspond. Discordant or dissonant waves do not recur in the same periods of time, and the troughs and crests of one set do not correspond to but may oppose the troughs and crests of the other set. While such expressions are descriptive of water waves and sound waves, they may not be applicable to ether waves, but they serve the purpose intended, that of making clear the relations between ether waves, which I desire to explain.

We have already learned that ferment products are inhibitory bodies which tend to and in their accumulation do arrest the fermentation. Do we not find an explanation of this mysterious inhibition phenomenon in the conditions under which these bodies are formed? Alcohol, for instance, inhibits vinous fermentation, of which it is the principal product. We have seen that when alcohol accumulates in vinous fermentation this process will be arrested when the accumulation of

alcohol reaches a certain definite percentage. There may be unfermented sugar and yeast cells ready to ferment it, but no fermentation will take place while the percentage of alcohol remains. *The sugar is immune to the activity of the yeast cells, and alcohol is the immunizing agent, because its wave energy opposes that of the yeast and sugar;* it is, therefore, an antibody.

Stahl, 1707, is entitled to the credit of having first formulated a theory of fermentation and putrefaction in which the causes producing the phenomena are purely physical agencies—molecular disturbances in the fermenting fluids. This conception of the nature of fermentation was adopted by Liebig, 1842, who held that the molecular disturbances which bring about fermentation are motions of decay which are imparted to molecules of a fermentable substance by the molecules of the albuminous substance undergoing decomposition. The molecular disturbances which cause fermentation are, according to Naegeli, 1852, the physical motions of atoms and molecules characteristic of these bodies.

The author's theory, while it is an outgrowth of that of Stahl, of Liebig, and of Naegeli, differs from these in important ways. For example, I hold that decomposition is caused not by direct bombardment, atom against atom and molecule against molecule, of the ferment upon the fermentable substance, as taught by Naegeli's theory, but that the conflict by bombardment which results in a dissociation and recombination of the fermentable substances into ferment products is between ether waves, atomic and molecular, produced by and corresponding to the motions of the atoms and molecules. The potential energy of the cell—say an yeast cell; that is, the capacity of the cell to do special ferment work—is a result of its structure, and is a reflex of its molecular ether waves. This potential energy of the cell becomes active or kinetic energy only when its waves meet in conflict with the waves of another substance, say sugar, which the former can decompose and transform into ferment products, alcohol, etc.

THE FERMENTATION THEORY OF INFECTION. Infection and fermentation, I hold, are analogous processes or phases of the same process and that both are due to the operation of the same physical and chemical laws. The active, obvious cause in both processes is a micro-organism or an enzyme, which is selective in its activity, in that a definite relation in molecular structure must exist between the acting substance and the substance acted upon before infection or fermentation can take place. The resulting products of the process, whether they be infectious or fermentative, are antibodies which tend to inhibit or to arrest the process of which they are the products.

The substances which pathogenic micro-organisms select to transform into the toxins of disease are the albuminoid molecules of the body

plasma. "The albumins or proteids are the most important food-stuffs which animals require for their existence. Albumins enter into the constitution of all the tissues and organs of the body and form the groundwork of every living cell. The phenomena of life, indeed, are dependent upon and centre in their presence.

"With few exceptions[1] the food-stuffs which the animal derives directly or indirectly from the plant cannot be utilized by the animal directly, but they must previously undergo certain changes which vary with the character of the individual substances. The native albumins must first be transferred into albumoses and peptones; the dissaccharids and polysaccharids must be inverted into monosaccharids, and the fats must be emulsified. We have seen in the chemical laboratory that these changes can for the most part be brought about through the action of superheated steam, by boiling with acids and alkalies, etc.—that is, through agencies that are not at work in the living world. The question, therefore, suggests itself, What are the means at the disposal of living animals to bring about these changes? This question has, in a measure, been answered—the animal capable of bringing about a large number of analytical changes by means of certain ferments or enzymes, which are furnished by the animal cells themselves. The better-known representatives of this class are essentially hydrolytic ferments, but there is evidence also of the existence of oxidation ferments.

"As the chemical processes which take place in the animal body are essentially of the character of hydrations and oxidations it would thus appear that other factors beside the ferments would be unnecessary for the functioning of the various organs. It is quite possible, indeed, that this is actually the same, and that the various manifestations of life may be explained upon the basis of fermentative phenomena."

Since the albumins of the tissue juices of the animal body constitute the pabulum from which its various tissues select nutritive substances required for their growth and the repair of their waste, the albumin molecules, using this term in the broadest sense, must exist in groups of many isomeric forms; and, while these groups possess the chemical and physical properties of albumin, they differ among themselves in greater or less degree in molecular structure. This conception of the molecular structure of the pabulum not only affords an explanation how body tissues of different kinds appropriate from a common source and transform into their own substance nutritive materials of the pabulum, but it also supplies an explanation how various kinds of micro-organisms find in the pabulum albuminoid groups which they can transform into kinds of toxalbumins.

We must not overlook the fact, however, that the tissue juices of

[1] Simon. Physiological Chemistry.

the animal body are essentially vital, and that the resistance of the molecules to decomposition is due to the same vital influence, probably of the nervous system, that resists destructive changes in the organism as a whole. This being true, groups of homologous molecules, whose structure bears certain exact relations to the molecular structure of certain micro-organisms, will more or less successfully resist dissociation by bacteria, *i. e.*, the animal body will resist infection by micro-organisms, according to the degree of normal resistance that is possessed by the molecules or by the organism. At the same time depressing influence, such as fear, fatigue, injurious drugs, emotional disturbances, etc., by diminishing resistance opens the road to infection.

Pathogenic Micro-organisms. A micro-organism is pathogenic to the animal body only when the latter contains molecules of albumin (proteid) which the former can transform into toxalbumins. Hence a micro-organism may be pathogenic to one species of animal, whose tissue juices contain susceptible albumin molecules, and not pathogenic to another species or variety of the same species of animal whose body juices do not contain susceptible albuminoids. Immunity of the animal body to a given micro-organism or to the disease caused by that microbe, as will be explained later, is due to the absence by destruction or inheritance of molecules of albumin which are susceptible to the special energy of the micro-organisms of the disease. Such micro-organisms are then not pathogenic to this organism, and they may remain in its tissues without producing specific disease.

A phenomenon that has proved a serious stumbling-block to the phagocytic theory of immunity is the markedly different behavior of the phagocytes to pathogenic bacteria in the bodies of immune and of susceptible organisms. In the immune animal the phagocytes flock to the point of invasion from long distances and attack and destroy the bacteria. The conditions are quite different when this same species of bacteria is introduced into the body of a susceptible animal. The bacteria are not now attracted by the phagocytes; on the contrary, they are repelled by them, in that the phagocytes retreat and permit the bacteria to infect the organism.

Under former teaching, that the pathogenic power of a bacterium is due to a secretion of the microbe, it is difficult to explain this phenomenon, but when pathogenesis is recognized to be the result of two factors—a species of micro-organism and a group of susceptible albuminoid molecules—the absence of either factor will prevent infection; and since the immune animal does not contain a group of albumin molecules which the micro-organism can transform into toxalbumins, infection cannot take place. The micro-organisms under such conditions are not pathogenic, and the phagocytes—the scavengers of the body—destroy them as they do other innocuous substances. In

the case of a susceptible animal the conditions are quite different. The body juices of such animals do contain susceptible albumin molecules which the micro-organism can transform into toxalbumins. It is these poisons that drive away the phagocytes and lead to infection, while it is the absence of toxalbumins in the immune animal that causes opposite phenomena to occur.

In concluding our remarks upon the nature and causes of infection, I wish again to emphasize the importance of certain principles which, I believe, are causatively concerned in the phenomena of both fermentation and infection, and, as will appear later, in those also of immunity.

The energy of a living cell, whether this be a ferment or a pathogenic cell, whereby the cell is made capable of doing special work, is derived from the ether waves which represent the molecular structure of the cell.

Since the manifestations of energy by living ferments and pathogenic cells are definitely associated with the molecular structure of such bodies, and since there are a vast number of species and varieties of both ferment and pathogenic micro-organisms, the capacity of such cells to do work which varies in character with the species and the varieties, is a reflex in each and every case of molecular structure. In other words, the manifestation of specific energy by ferment and pathogenic cells, which varies with the species and variety of the micro-organism, is a result of specific differences in molecular structure of the cells of the different classes.

The specific energy of the living ferment or pathogenic cell is capable of converting substances into ferment or pathogenic products whose molecular structure—that is, molecular waves—do not deviate too far from the molecular structure of the cell.

The energy of atomic and molecular ether waves is increased or diminished by related ether waves according to the degree of interference that results from their conjunction. When the waves of one set correspond in time and periods with those of another set, their conjunction causes an increase of wave energy; on the other hand, when the two sets of waves do not correspond in time and periods, but the waves of one set recur in periods directly opposite to the waves of the other set, the wave energy is apparently destroyed (quenched, antagonized) by conjunction of the two sets of waves.

Of the many theories of immunity but three have at present any considerable following. They are the humoral theory of Buchner and his associates, the cellular or phagocytic theory of Metschnikoff, and the side-chain theory of Ehrlich. According to the humoral theory the destruction of pathogenic bacteria in the living organism is due to the bactericidal action of the blood plasma. Buchner and his school have shown that freshly drawn blood, blood plasma, defibrinated blood,

aqueous humor, tears, milk, urine, and saliva possess marked destructive influence upon micro-organisms brought in contact with them, and that this influence is destroyed by exposure to sunlight, the mixture with serum from another species of animal, and by heating blood serum to 55° C.

In 1881 Carl Rosser called attention to a power which the phagocytes of both animals and plants have of incepting, digesting, and assimilating living micro-organisms; and he maintained, as a result of his observations, that leucocytes of an immune animal can destroy bacteria which are themselves destructive to susceptible animals. Metschnikoff, working on the same lines, confirmed the earlier observations of Rosser, and from observing what appeared to be a contest between the white blood cell of the water-flea and certain infectious micro-organisms, he was led to believe "that in every case of infection it is the white-cell elements of the blood that, as scavenger cells (phagocytes), have to save the organism if they can. If bacteria attack any part of the body, these cells, favored by their mobility, at once appear at the place of danger and rush upon the invaders. If they are able to make the latter innocuous, no affection takes place; if, however, these defenders of the organism struggle ineffectually and yield, the enemies begin to multiply and spread themselves over the unprotected domain."

The side-chain theory of immunity is an outgrowth of Ehrlich's studies into the nature of toxins and antitoxins, and it expresses his views of the nature of the changes in the tissues and plasma cells of the body which take place in immunization. Of the many atom groups which compose cell structure certain permanent groups are concerned in maintaining and perpetuating the cells, while other groups called "side chains" or "receptors," which are supposed to be multifarious in special chemical affinities and in numbers, are particularly occupied in cell nutrition. In the exercise of this function the "receptors" attract to themselves such nutritive material of the plasma or toxins contained therein which have special affinities for the "receptor," and though the intermediation of the receptors combine such substances with the cells. Now, infection of the cells by toxins is produced, according to Ehrlich, in the same manner and by the same agency that nutrition of the cells is produced. In this instance toxin molecules in the plasma which have the required affinities are seized by cell receptors, and through the intermediation of these bodies the toxins exert their harmful influence upon the cells themselves.

Certain anomalous results obtained by Ehrlich in standardizing diphtheria toxin led him to conclude that the toxin molecules have two distinct atom groups, one of which is destroyed by exposure for a half-hour to a temperature of 56° C., while the other remains active under this exposure. The thermostabile groups—the "haptophore groups"

or simply the "haptophores" of the toxin molecule—are concerned chiefly in neutralizing the toxin, while the thermolabile groups—called the "toxiphore groups" or simply the "toxiphores"—constitute the toxic part of the molcule. "Toxoids" are toxin molecules which have lost their "toxiphores," but retain their "haptophores." Ehrlich claims that the anomalous results he obtained in standardizing diphtheria toxin were due to the presence of toxoids in the sera.

Now, as a cell can be reached by nutritive stuff or by poison stuff only through the intermediation of specific receptors, and as the function of these bodies is destroyed or much impaired when they become infected, they must be cast off and reproduced, when infected, or the cell must perish from starvation.

It is assumed, therefore, that cells which have not been destroyed by the toxin, but have sustained injuries which they may overcome, will cast off the infected side chains, and will replace them by new ones, and in excess of the capacity of the cell to retain. The result of this excess in production of side chains is the appearance of "receptors" in the blood stream as free bodies, and as they retain their combining powers they may unite with homologous toxin molecules, and thus protect the cells from further infection by the toxin, and will give to the animal body thus protected antitoxic immunity, the free receptors being antitoxins.

The following phenomena are apparently not in harmony with this theory of antitoxic immunity. "Guinea-pigs and men who have withstood a tetanus infection and are very resistant may contain no tetanus antitoxin." Rabbits which have been immunized to tetanus will succumb to an intracerebral inoculation of a small dose of tetanus toxin. Many animals, such as rats, hens, and alligators, after inoculation with tetanus toxin, produce great quantities of antitoxin without previously showing any signs of the disease. Finally, in the production of antitoxin by toxin, say, of diphtheria, the quantity relations of the toxin to the antitoxin in the process are those of a ferment and its products, rather than those of a chemical combination. A unit of toxin may cause the production of about 10,000 units of antitoxin; the production may be largely increased by repeated venesections of the immunized animal, so that there may be withdrawn a quantity of antitoxic serum out of all proportion to the quantity of toxin used; and yet, at the end, the animal can supply a serum of nearly the same antitoxic power as at first. This phenomena is strikingly like that which occurs in alcoholic fermentation, when by repeated removals of alcohol, arrested fermentation may be re-established and more alcohol produced. It seems that in both cases increased production following removal is due to the weakening or destruction of inhibitory influences which tend by their presence to arrest the processes.

Bacteriolytic immunity is due to specific lytic qualities which the blood acquires in adapting itself to infectious cells that have been introduced into the body. It has been shown that when various kinds of cells, their products or derivatives, are introduced into the peritoneal cavities of animals at certain intervals, the blood serum of the treated animals will undergo changes of the most exact and delicate kind, and that there will be developed antibodies in the plasma to the bodies introduced. For example, the introduction at intervals of attenuated infectious cells into a susceptible animal will, in the process of immunizing the animal, cause the development of lysins in its body which are capable of destroying such cells. If red blood cells are introduced, the serum of the animal treated becomes hæmolytic; when epithelial cells or hepatic cells or spermatozoa are introduced, the serum is lytic for the epithelial, the liver cells, or the spermatozoa, according to the kind of cells introduced. If pathogenic bacteria are introduced the blood serum becomes lytic for the bacterium. It should be noted that the relation between the cells introduced and the adaptive changes which take place in the blood serum of the animal treated is exact and specific in character.

Ehrlich in his side-chain theory offers the following explanation of these phenomena, which, of course, includes those of bacteriolytic immunity. He concludes that the lytic power of blood serum resides in the thermolabile constituents of normal blood which he terms the "complement." The complement is incapable, however, of combining directly with foreign cells to be destroyed; an intermediate body is necessary. The intermediate body is a thermostabile substance which is found only in immune blood and called the "immune body," or more commonly the "amboceptor" as it has two atom groups, one of which unites with the complement, while the other unites with the cells that are to be destroyed. Complements and amboceptors are believed to exist in immune blood in great variety and of many chemical affinities, enabling them to exercise specific and exact selective powers.

The origin of amboceptors is believed by Ehrlich to be the same as that of antitoxin; but Metschnikoff, who has modified his views of phagocytosis so that they are more in harmony with Ehrlich's views, insists upon the phagocytic cells as the originators of substances concerned in cytolysis, and, in recognition of its ferment character, he has given the name "cytase" to the complement, and that of the sensibilizing substance (*substance sensibilisatrice*) to the immune body—amboceptor.

The natural resistance of the animal body to any given type of infection, which condition is not necessarily associated with that of robustness or vigor of constitution, may be lessened or temporarily destroyed by various means; for illustration, the natural resistance of

chickens to anthrax may be overcome by reducing the bodily temperature of the chickens (Pasteur). The natural resistance of rats to anthrax may be destroyed by forcing them to turn a revolving wheel until they become exhausted (Roger). The immunity of white rabbits to anthrax may be overcome by feeding or by injecting into them phloridzin, so as to induce a glycosuria (Leo). Now, assuming that natural resistance to infection is due to an absence or poverty of side chains, it is difficult to conceive how such absence or poverty can be overcome by the conditions mentioned.

The difficulties which confront the side-chain theory will be increased in magnitude and number when we seek an explanation of variability in duration of acquired immunity. To assume that immunity acquired from a given species of bacterium is due to the presence in the organism of specific amboceptors requires us to believe (*a*) that these bodies are continually present during the period of immunity—probably during the life of the person, (*b*) that there exists in the blood specific amboceptors representing each and every disease from which the person has acquired immunity, and, finally, as a condition of permanent immunity can only be maintained by a permanent supply of fresh amboceptors to replace those worn out, the side-chain theory requires us to believe that these bodies possess the power of reproduction.

The forces involved in the fermentation theory of immunity are those operating in nature within and without the living organism. They are the forces which constitute motion in matter, and are the same when manifested in the operations of the telephone, the phonograph, or in wireless telegraphy, that they are in bringing about atomic rearrangement in albumin molecules in the production of immunity. The centres of activity of these forces in the production of acquired immunity are the albumin molecules of the plasma and tissue cells of the living organism. It is known of these bodies that they are massive in size, complex in structure, unstable in composition, are plastic in adaptive processes, and that the distance from normal albumin to poisonous toxalbumin is not far. Further, it is believed that albumin molecules of the body juices and cells exist in homologous groups of great variety—isomers of albumin. That similarity in atomic arrangements and in molecular energy between the molecules of the plasma and the cells of the body affords the latter selective activities in nutritional processes, and in the same way a similarity in molecular structure and energy of a toxin or of foreign cells and plasma albumin molecules will give the former selective power in producing infection and immunity.

It is seen, therefore, that the fermentation theory, in many respects, runs parallel to the side-chain theory of immunity; especially so, when

we consider the tendency of modern science to refer chemical action in its ultimate analysis to physical motion.

The source of energy manifested by a pathogenic micro-organism has already been described, and it has also been shown how such energy brings about a dissociation of susceptible albumin molecules of the living body, and why the dissociated atoms recombine into antitoxins and thus cause the development of antitoxic immunity of the organism.

As this form of immunity is due to neutralization of the toxin by the antitoxin, and as it has neither bacteriolytic power nor the ability to prevent the conversion of albumins into toxalbumins by the micro-organisms of the disease, it is necessarily short-lived.

It is a matter of common observation, however, that immunity which follows an attack of disease in many forms of infection, and also that which follows inoculation with the toxin or with attenuated forms of the microbe, may be of long duration, possibly during the life of the person. This form of immunity is generally believed to be due to an acquired capacity of the immune body to destroy invading bacteria, and is, therefore, called "bacteriolytic immunity." Those who hold to this theory are called upon to explain the following phenomena which seriously militates this view, and which, so far as I know, remains unanswered. The bacillus typhosus may remain as a harmless parasite in the gall-bladder and in post-typhoid bone abscess in immune persons for years; the bacillus subtilis may remain unattacked in the infected spleen for an indefinite period of time. Query—Why does not the bacteriolytic serum destroy the microbes, and why is the patient not reinfected by the bacillus typhosus?

These difficulties do not confront the fermentation theory, which holds that two factors are necessary to infection of the living organism, viz., (*a*) the presence of susceptible albuminoids, and (*b*) the presence of the pathogenic micro-organism. The absence of either factor will prevent infection.

Now, I call the second form of immunity, that which usually, but not necessarily, gives long protection to the organism, *somatic immunity*, in contradistinction to the first variety, antitoxic immunity. The operating factors in the two varieties are the same, but the effects produced are different. There is a complete dissociation and a rearrangement of susceptible albumin molecules into antitoxin—a foreign and non-nutritive substance—in antitoxic immunity; while in somatic immunity, the susceptible molecules are not dissociated and do not lose their nutritive value, but the atomic arrangement of the molecules is changed by the energy of the toxin, and in consequence of this such molecules lose the susceptibility to the micro-organism that previously existed. It follows, therefore, that the micro-organism previously

pathogenic to the person is no longer so, and it may remain indefinitely and without harm in the tissues of his body.

In speaking of the susceptibility of albumin molecules to the energy of the toxin of a given micro-organism, we must not lose sight of the relation in molecular structure, pointed out by Emil Fischer, between a ferment and the substance it can decompose, and which must exist, before the one can affect the other. This relationship must also obtain between the molecular structure of the micro-organism and homologous groups of albumin molecules before the micro-organism can convert the molecules into toxin. Now, the toxin is necessarily an antibody to the micro-organism just as alcohol is an antibody to the yeast cells; it is, also, an antibody to other substances whose wave energy coincides with that of the micro-organism. The group of susceptible albuminoids come in this category, and the toxin is, therefore, an antibody to this group just as alcohol is an antibody to grape-sugar.

This explanation will enable us to better understand the rationale of action between the toxin, the micro-organism which produced it, and the susceptible group of albumins whose molecular structure may be rearranged by the toxin and thus thrown out of harmony with and consequently immune to the micro-organism. It will be noted that the toxin is an antibody both to the group of susceptible albuminoids and the micro-organisms, and as the two last named must coincide in wave energy that one may dissociate the other, it follows that the wave energy of the toxin must oppose both alike. We are now confronted by two facts: the first is that the wave energy by which the toxin attacks the albuminoid group is not a direct energy, such, for example, as is that which results in the production of antitoxin, but is a reverse energy—that is, an opposing energy; our second fact is that the toxin is an enzyme and is more stable in atomic bonds than are the albuminoids. Now, when reverse wave currents meet, one will destroy the other if their energies are equal; when they are not equal the stronger will first neutralize the wave energy of the weaker, and then with the remaining energy will cause an atomic rearrangement in the molecular structure of the weaker substance—the susceptible groups of albumin molecules. We can readily understand why this energy may not be sufficient to dissociate and yet be ample to produce a molecular rearrangement in the weaker body. Now, a molecular rearrangement of a substance, say, of an homologous group of albumin molecules, may destroy the susceptibility to a given species of bacterium without destroying the nutritive value of the molecules. Molecules thus changed will be thrown out of harmony in synchronous molecular vibration with the species of bacterium to which they had previously been susceptible and cannot be transformed into toxins by this species. Somatic immunity, I hold, is a condition of atomic rearrange-

ment of susceptible molecular groups of the organism, so that their susceptibility to a given species of bacterium is more or less permanently destroyed. Since the albumin molecules are susceptible to micro-organisms because of certain structural similarities held in common by the two, susceptibility will be destroyed, and this group of molecules will become immune to the micro-organism when the structural similarities held in common cease to exist. It is understood, of course, that immunity of the albumin molecules carries with it immunity of the organism, and that permanency in duration of one coexists with permanency in the other.

The more permanent duration of protection which usually characterizes the somatic type of immunity, and that which distinguishes this type from that produced by antitoxins, is due to the fact that atomic rearrangements of albuminoid groups, brought about by reverse-wave energy of the toxin, show a marked disposition to permanency.

The contention that atomic rearrangement may be permanent in character is not unsupported by evidence; it is well known that changes in molecular cell structure may be produced artificially and that such changes may be transmitted from parent to progeny through many generations of the cells. I refer to the changes produced in cells by "attenuation." It has been shown that the capacity of a ferment or pathogenic cell to bring about decomposition changes in susceptible substances and to produce specific products may be increased or decreased, destroyed and restored at the will of the operator by exposing such cells to attenuating influences or agencies. It has further been made known that the capacity of a cell to produce ferment or infectious products is not a vital capacity, inasmuch as it can be destroyed without doing injury to the cell in its capacity to grow, to assimilate or to propagate itself. Since the capacity of a cell to excite fermentation or pathogenic changes is not a vital capacity, and since this capacity may be variously modified or destroyed by physical agencies, I have argued that the forces concerned are physical, and have pointed out their nature and origin. Now, since the condition of "attenuation" of bacteria and ferment cells is due to atomic rearrangement of cell structure, which may become permanent and may be transmitted from parent to progeny, and since the changes produced in the plasma and tissue cells of the body by toxins are also atomic rearrangements, the same degree of variation in permanency of acquired structure will apply alike in both cases.

Before concluding this essay, it is but fair that I point out as I see them what may be regarded as weak places in the fermentation theory. The existence of atoms has never been absolutely proved, the atomic theory being accepted as true because it serves to explain and make intelligible chemical phenomena which otherwise would be obscure and inexplicable.

The evidence that atoms (molecules) possess a motion of translation and that this is the source of radiant heat is almost positive; but the proof that they also possess an interior motion is less conclusive. Many scientists believe, however, that atoms not only have interior motions, but that such motions are primordial and ultimate, and are therefore indestructible. "That the molecule (atom) does not get its interior motion from the heat of dissociation is certain, for on being allowed to recombine it yields up its translatory activity and with it as many degrees of temperature as disappeared in accomplishing its dissociation. We must not endow the molecule (atom) with gratuitous attributes, but it is surely an entity of some kind, having, in the first place, persistent and regulated motion; secondly, it has inertia, or mass, the property of conserving '*vis-viva*.' Thirdly, it has some bond with its fellow by which the motions of both are modified by constant stress, according to a definite law of distance; and this, following Newton, we call *attraction*. Fourthly, it has the complex property of interchange of momenta, accompanied by that of conserving the compounding motion by angular rebound upon an infinitely near approach, which we call 'resiliency' or 'repulsion.' It is conceived as having dimension, figure, polarity, elasticity, and harmonic vibration, with periods as undeviating as those of the 'moons of Mars.'"

The fermentation theory is based upon the hypothesis, in the absence of positive supporting proof, that the interior motions of atoms are transmitted to the surrounding ether as wave motions of energy, just as the translatory waves of atoms are transmitted in the development of ether waves of radiant energy, heat, and light. Proof that the interior specific motions of atoms transmit to the ether related vibrations (waves) must rest for the present, as the atomic theory does, upon the competency of this theory to intelligently explain large groups of physical phenomena which otherwise are obscure and inexplicable.

Professor Julius Thompson (*thermochemical investigation*) says: "Theoretical chemistry is based upon the molecular theory, according to which all matter is made up of molecules and these molecules of atoms. The physical state of bodies depends upon the arrangement and motions of the molecules; the other physical and chemical properties depend upon the kind and number of atoms in the molecule, upon their arrangement and relative motions."

Now, this statement as it stands does not convey to the mind how "the number and kinds of atoms in the molecule, their arrangement and relative motions," give to matter the chemical and physical properties it possesses. The statement is simply one of fact, and is not an explanation of the nature of the forces which bring about the chemical and physical changes referred to. The chemical and physical properties of matter and the rationale of their action will become intelli-

gible, however, when it is understood that the latent or potential energy of matter is the sum of energy of its molecular ether waves which become active or kinetic energy, capable of molecular dissociations and reassociations when, under favorable conditions, it is brought in contact with molecular structure whose wave energy bears a definite, required relation to the molecular wave energy of the first.

Michael Foster, in discussing physiological problems, has this to say: "We have, in speaking of protoplasm, used the words 'construction,' 'decomposition,' and the like, as if protoplasm were a chemical substance. And it is a chemical substance, in the sense that it arises out of the union or coincidence of factors which can be resolved into what the chemists call 'elements,' and it can be at any time by applying the appropriate means, broken up into the same factors, and, indeed, into chemical elements.

"This is not the place to enter into a discussion of the nature of the so-called chemical substances, or, what is the same thing, a discussion concerning the nature of matter; but we may venture to assert that the more these molecular problems of physiology with which we are now dealing are studied, the stronger becomes the conviction that the consideration of what we call 'structure' and 'decomposition' must, in harmony with the modern teachings of physics, be approached under the dominant conception of modes and motion.

"The physicists have been led to consider the qualities of things as expressions of internal movements; even more imperative does it seem to us that the biologist should regard the qualities (including structure and composition) of protoplasm as in like manner the expression of internal movements.

"We must not pursue the subject any farther here, but we feel it necessary to introduce the caution concerning the word substance; we may repeat the assertion that it seems to us necessary for the satisfactory study of the problems on which we have been dwelling to keep clearly before the mind the conception that the phenomena in question are the result, not of properties of the kinds of matter, in the vulgar sense of the word, but of kinds of motion."

The "kinds of motion" in matter capable of producing "the phenomena in question" are not described by the distinguished physiologist and author whom I have quoted. The motions of atoms and molecules do not of themselves satisfy the understanding, as such motions alone are incapable of accounting for the energy manifested specifically by matter in its various forms. Something else is needed to make the forces of "construction," "decomposition," and the like intelligible, and this something, I claim, is supplied by the theory that vibrating atoms produce in the ether corresponding vibrations.

# REVIEWS.

ANATOMY OF THE BRAIN AND SPINAL CORD, WITH SPECIAL REFERENCE TO THE GROUPING AND CHAINING OF NEURONES INTO CONDUCTION PATHS. For Students and Practitioners. By HARRIS E. SANTEE, M.D., Ph.D. With a preface by WILLIAM T. ECKLEY, M.D. Third edition, revised and enlarged. Chicago: E. H. Colegrove, 1903.

A CAREFUL and clear description of the anatomy of the central nervous system is given in this book by an author who thoroughly understands his subject, and possesses the by no means common faculty of being able to present it intelligibly to his readers. In the following order are described the membranes, the external surfaces of the cerebrum, the ganglia, the third ventricle, and interbrain. The reader is then led through the mid-brain to reach a chapter in which the neurones and their functions are explained; the cortical ganglionar and central gray matter detailed in its ultimate structure; and the projection, commissural, and association fibres traced. This takes one half through the book. Hind-brain or cerebellum, after-brain or medulla, fourth ventricle, and spinal cord are well treated in the order given.

It must be said that Dr. Santee's book lacks one very important feature in a work of this kind; namely, plates and diagrams. Only two illustrations appear—the mesial and external surfaces of the brain. So necessary are pictures to an adequate understanding of this intricate subject, that the cleverest description would be likely to embarrass the student whose mind did not already carry graphic representations in their absence. In connection, however, with other works containing them, and the possession of material for macroscopic and microscopic study, the book has its distinct value, as the author at times has an original manner of presenting intricate portions of the subject, so that points difficult of understanding are simplified. For instance, in describing the internal capsule, he speaks of it as a "funnel-like group of fibres." "The bell of the funnel opens upward and outward, and contains the lenticular nucleus; its solid spout, directed toward the pons and medially, is the crusta. Anteroinferiorly the fibres in the bell of the funnel diverge to opposite sides of the fissure of Sylvius and produce a break in its continuity, the hiatus Sylvii; otherwise the funnel is complete. As the internal capsule proceeds into the hemisphere, it impales the corpus striatum in such manner as to place the caudate nucleus and amygdala upon the circumference, and to inclose within its walls (to capsulate) the lenticular nucleus." This helps the student to form a conception, that he must build from sectional views, of the relations in all dimensions of capsule to ganglia, etc.

The book is made more interesting and impressive by frequently mentioning the functions, when the anatomy of regions or paths is

detailed. With the description, for instance, of the anterior horn cells are the clinical results of their degeneration pointed out. There is a chapter on the "Tracing of Impulses," which sums up in an able manner the paths conducting motor and sensory impulses and the reflex acts. The book very properly ends with a section devoted to the embryology of the nervous system. A very complete index and the space offered for notes or drawings by interleaves throughout the volume are conveniences. H. C.

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MODERN MATERIA MEDICA AND THERAPEUTICS. By A. A. STEVENS, A.M., M.D., Lecturer on Physical Diagnosis in the University of Pennsylvania; Physician to the Episcopal Hospital and to St. Agnes' Hospital; Fellow of the College of Physicians of Philadelphia, etc. Third edition, entirely rewritten. Pp. xiv., 663. Philadelphia, New York, and London: W. B. Saunders & Co., 1903.

WE recall very distinctly the predecessor of this edition—a very readable and reliable book. The present comes to us rewritten as the advances in the subjects considered demand and the experience of the author enlarges. Not only by its larger size and its more positive statements does it appeal to us, but especially because the author has recognized that an arrangement of methods and materials according to the initial letters of their names is not the best for the student who wishes to know relations as well as facts. The alphabet as a source of classification—if classification it be—has been abandoned and pharmacology substituted. This arrangement, based on pharmacological action, is, to our mind, a great improvement; imperfect as our information may be, facts correlated are more easily acquired than facts isolated. After general considerations, including definitions, various information concerning composition and preparation of drugs, incompatibility, methods of administration, and circumstances modifying the effect of drugs and and their dosage, we come to a consideration of these remedial agents, beginning with circulatory stimulants on page 38, and ending with various flavoring agents on page 466. Here the various official drugs and approved new pharmacopœial remedies are forcibly and fairly presented, both as to their physiological action and therapeutic uses. As for the orthography of this section, as well as of the rest of the book, it is certainly advanced, and so far as pharmacopœial terms are concerned, it is premature. If the terms fixed by established authority happen not to be in harmony with editorial notions, they should remain caudate until that authority moves. Remedial measures other than drugs are briefly presented and dismissed in thirty-two pages.

Applied therapeutics begins with acute infectious diseases, constitutional diseases, those of the blood and ductless glands, digestive tract, respiratory system, circulatory system, kidneys, and ends with diseases of the nervous system. If the reader expects that this will be merely an expansion of the perfunctory and thoroughly unsatisfactory index of diseases he will be mistaken, for here some of the author's best work shows itself. There is also evidence of extensive reading and judicial discrimination. We have perused this later presentation of the author's knowledge with great interest and, we trust, profit. We find this edi-

tion, both in scope and arrangement, a decided advance over its predecessor, and we predict that in these respects its appreciation by the profession will keep pace.

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A CHART OF THE THREE GREAT SYSTEMS—ARTERIAL, VENOUS, AND NERVOUS. Published by Dr. G. H. Michel & Co.

THE chart is of a human figure, thirty inches in height, showing in a good deal of detail the arterial, venous, and nervous systems, with their branches, ramifications, and relations to each other and to other parts of the human anatomy. It is printed on canvas in bright colors, and should be of some value in elementary teaching. There is a brief text in explanation at the sides of the picture corresponding to letters and numbers on the figure itself. G. M. C.

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A TREATISE ON MATERIA MEDICA AND THERAPEUTICS, INCLUDING PHARMACY, DISPENSING, PHARMACOLOGY, AND ADMINISTRATION OF DRUGS. By RAPHALDAS GHOSH, L.M.S. Cal.Univ., Lecturer on Materia Medica, Calcutta Medical School. Calcutta: Hilton & Co., 1903.

A WORK on materia medica and its allied branches is rarely considered an attractive subject for steady reading, but rather as for reference, and as such this volume will be of use. It is written for the use of medical students, particularly those of the Calcutta Medical School, and while rather too voluminous for an ordinary text-book, it should be placed in the category of those books designated in the catalogues of American medical schools as collateral reading. It is an exhaustive work, going into the different branches of the subject in considerable detail; but one gets the impression of its subject-matter being crowded together and abbreviated to suit the requirements of a single volume. It is poorly bound and printed on poor paper, and there are many typographical errors. The fact that it is arranged to correspond to the British Pharmacopœia detracts considerably from its value to an American student. G. M. C.

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A TEXT-BOOK OF THE HISTOLOGY AND MICROSCOPIC ANATOMY OF THE HUMAN BODY, INCLUDING MICROSCOPIC TECHNIQUE. By LADISLAUS SZYMONOWICZ, Extraordinary Professor of Histology and Embryology in the University of Lemberg. Translated and edited by JOHN BRUCE MACCALLUM, M.D., Johns Hopkins University, Baltimore. Illustrated with 277 engravings, including 57 plates in colors and monochrome. Philadelphia and New York: Lea Brothers & Co., 1902.

THE volume before us is a veritable pleasure, and the instructor and student whom good fortune leads to secure it will find themselves in an enviable position from which to study histology and microscopic anatomy.

A text-book which comes to us under the sign and authority of so distinguished an investigator in the field of microscopic anatomy as Dr. MacCallum is sure to find a ready place and hearty welcome, and an examination of the contents fully justifies the high position accorded it. The text is admirable, and the illustrations, both colored and other, as good as the publisher's art can make them.

The volume is based upon the valuable plan of tracing, as far as may be, the development of the organs and the histogenesis of the tissues, from which viewpoint the histology is considered. The editor has, moreover, emphasized the structural units of organs with which idea the work of his master, Professor Mall, has been so richly rewarded. Besides the original descriptions and plates, many additions have been introduced, as in the section on the medulla and mid-brain, where the invaluable assistance of Dr. Florence R. Sabin has been available, and in still other sections, *i. e.*, the lymphatic glands, where Calvert's diagram is introduced, and the adrenal, in which Flint's reconstruction is made use of.

The descriptive diagrams with which many of the full-page lithographs are supplied are excellent. No better method for unravelling the intricacies of microscopic anatomy is available, and the fulness, precision, and clearness of both drawings and descriptions are most commendable. F.

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LE TRAITÉMENT DE LA CONSTIPATION. Par le DR. FROUSSARD. Paris: J. B. Ballière et Fils, 1903.

THIS short treatise on the treatment of constipation is, as the title implies, chiefly devoted to physiological methods of treatment, including massage, hydrotherapy, electrotherapy, and gymnastic exercises, and contains many useful hints for the management and cure of this baffling and annoying symptom. The author's conception of the pathology of constipation is not without originality. He divides the cases into three groups, according as spasm or atony—the two principal causal conditions—predominate or coexist and alternate one with the other. In the first group the large intestine is resistant, contracts vigorously and even painfully on excitation with the palpating hand; there is distention, but not dilatation. The second group is characterized by both spasm and atony; that is, the two conditions alternate. The bowel is described as in a condition of "exaggerated and temporary repose." The third group, which comprises the most inveterate cases, is marked by a total absence of spasm; the intestine cannot be felt directly, and its position in the abdomen can be made out only by palpating the fecal contents. Great stress is laid on the necessity of recognizing the presence of spasm, as it has an important bearing on the choice of therapeutic methods. At first only functional, the hypertrophy of the muscle if it persists becomes structural, and unless the muscular coat is relieved of the extra work hypertrophy is eventually replaced by atony. Treatment is discussed under two heads, that of spasmodic and that of atonic constipation. These chapters contain full directions as to regimen and diet, as well as a description of the various electric, hydrotherapeutic, and mechanotherapeutic methods of treatment, with their indications

and full technical directions. Massage and hydrotherapy, including the internal use of water or "coloclysis," the technique of which is fully described, should form the main dependence of the therapeutist; laxatives are admissible solely for the purpose of exciting a single evacuation, never as routine remedies. R. M. G.

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"Les Actualités Médicales." La Goutté et son Traitément. By E. Apert. Paris: J. B. Ballière et Fils.

Apert presents in this work, which is one of a series of essays, an admirable review on gout. He gives the classical picture of gout, and, as would be expected, has drawn most of his material from English sources, although Trousseau, Dielaufoy, Bouchard, Béclère, and others have been freely quoted. Several radiographs illustrating the difference in the affections of the joints in gout and chronic rheumatism are of value, as well as those of the deformities and the tophi commonly seen in severe cases. The chapters on the Attack of Gout; Gouty Temperament: Gout, its Evolution, Abarticular Forms and Etiology, present the classical picture so often described.

The chapters on treatment are thorough, and especially interesting are those relating to the hydromineral treatment and to the newer remedies, all of which are mentioned, as is their composition. The chapter on Hydromineral Treatment should prove especially valuable when one is in doubt as to which particular bath or cure a certain case be referred. Apert aptly closes by insisting on the value of care, diet, exercise, and hygiene as far exceeding the value of any or all drugs. E. A. H.

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Atlas and Epitome of Human Histology and Microscopic Anatomy. By Dr. Johannes Sobatta. Edited, with extensive editions, by G. Carl Huber, M.D. Authorized translation from the German. With 171 illustrations on 80 lithographic plates, and 68 text illustrations. Philadelphia and London: W. B. Saunders & Co, 1903.

The poverty in the English language of text-books on histology has been turned in the last few years into a state of plentitude that is rapidly becoming embarrassing. The teacher of histology is confronted at this day, in the selection of a text-book for students, with a perplexing problem, but the perplexity arises not from the inadequacy of the available books, but because of the difficulties of choosing between those of excellent merit. This condition is, to say the least, a desirable one, and one that reflects the changes which have come over the manner of teaching histology in medical schools. The growth of laboratories and of objective teaching of all kinds, and the replacement of "show" specimens of cells and tissues with the objects prepared by the student, whose property they become, have brought, by necessity, an improved form of manual adapted to the wider uses of a broadened course in histology. Two essentials are now required of a text-book on histology: the text

should be modern and prepared by a specialist, and the illustrations should be copies from nature and reproduced with becoming fidelity. These essential conditions are easily fulfilled by the volume under consideration. The author and the editor both are distinguished histologists; the text is, therefore, of the utmost trustworthiness, to which may be added that it is also written with such degree of lucidity that the student is never at a loss to interpret the meaning. The illustrations are above criticism, and of such number and variety as to supply every wish, not only of the student, but also the more advanced scholar of histology. The English language has been greatly enriched by the addition to it of the present volume, and both editor and publisher are to be felicitated upon their excellent work. F.

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A System of Physiologic Therapeutics. A Practical Exposition of the Methods other than Drug-giving Useful in the Prevention of Diseases and in the Treatment of the Sick. Edited by Solomon Solis Cohen, A.M., M.D., Senior Assistant Professor of Clinical Medicine in Jefferson Medical College. Vol. V., Prophylaxis, Personal Hygiene, Civic Hygiene, and the Care of the Sick. By Joseph McFarland, Professor of Pathology, Medico-Chirurgical College, Philadelphia; Henry Leffmann, M.D., Professor of Chemistry in the Woman's Medical College, Philadelphia; Albert Abrams, A.M., M.D., formerly Professor of Pathology, Cooper Medical College, San Francisco; and W. Wayne Babcock, M.D., Lecturer on Pathology and Bacteriology, Medico-Chirurgical College, Philadelphia. Illustrated. Philadelphia: P. Blakiston's Son & Co., 1903.

In this volume of what may properly be termed an Encyclopædia of Physiologic Therapeutics is given what the editor is modestly pleased to call an Epitome of what is Essentially the Natural History of Medicine and an Introduction to the Science of Medicine. It treats, as is stated in the preface, "especially of the preservation of health and the prevention of disease, seeking a basis for intelligent prophylaxis in a study of morbid processes and their causation." In Part I., on the Origin and Prevention of Disease, by Drs. Joseph McFarland and W. Wayne Babcock, are presented, with great clearness and thoroughness, health and its defences; the intrinsic factors of disease; extrinsic causes of disease—inanimate, animate, biological poisons; the diffusion of disease through air, water, and soil; the method of transmission of disease by animals; conveyance of parasites by foods; social intercourse as a factor in the transmission of disease; modes of parasitic invasion, action, and elimination; immunity; artificial defences; asepsis, antisepsis, and disinfection; prevention of the transmission of disease by animals; alimentary, respiratory, cutaneous, and venereal infections, and circulatory inoculations. The information presented in the 305 pages which this part occupies is enormous in amount, and it is all solid matter, with no padding. Necessarily, there is an absence of that literary style that makes easy reading and holds the attention, but everything is clearly and, with few exceptions, correctly stated.

Part II., on Civic Hygiene, by Professor Leffmann, deals with sites and plans, streets, open spaces, roadways, street cleaning, nuisances,

offensive trades, city noises, public buildings, tenement-houses, roof-gardens, sanitary authorities, hospitals, quarantine, notification, control of venereal diseases, food supply, and water supply, disposal of waste, of sewage, and of the dead. To those who are familiar with Dr. Leffmann's other work it is hardly necessary to remark that this portion is entertainingly written, and is authoritative. Dr. Albert Abrams, in Part III., on Domestic and Personal Hygiene; Nursing and Care of the Sick-room, treats fully and clearly of the hygiene of dwellings, ventilation, heating, lighting, plumbing, school hygiene, hygiene of travel, clothing, bathing, rest and recreation, and a host of important topics connected with nursing. Like the other parts of the book, this is well done and will well repay reading. Taken as a whole, the volume is an exceedingly valuable book of reference, and should have a wide sale.

C. H.

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MEDICAL JURISPRUDENCE, INSANITY, AND TOXICOLOGY. By HENRY C. CHAPMAN, M.D., Professor of Institutes of Medicine and Medical Jurisprudence in the Jefferson Medical College of Philadelphia. Third edition, thoroughly revised. With 64 illustrations and 4 plates in colors. Pp. vii., 329. Philadelphia, New York, and London: W. B. Saunders & Co., 1903.

THIS manual, based on the author's experience of six years as coroner's physician, is evidently intended to give to the student a general survey of the subject rather than to serve as an aid to experts and others interested in court practice. Necessarily, in such a brief survey, many omissions of important points must occur, and the treatment of most of the subjects must be somewhat too general to be of much value. The part devoted to toxicology is especially inadequate. The present edition is, as a whole, an improvement over its predecessors, like which it may be regarded as a perfectly safe guide to the study of more comprehensive works.

C. H.

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A TEXT-BOOK OF LEGAL MEDICINE AND TOXICOLOGY. Edited by FREDERICK PETERSON, M.D., Chief of Clinic, Department for Nervous Diseases, Columbia University; and WALTER S. HAINES, M.D., Professor of Chemistry, Pharmacy, and Toxicology, Rush Medical College, Chicago. In two volumes. Volume I. Pp. 730. Philadelphia, New York, and London: W. B. Saunders & Co., 1903.

THE object of this work, of which this is the first volume, is, as stated in the preface, to give to the medical and legal professions a fairly comprehensive survey of forensic medicine and toxicology in moderate compass. Unlike most recent works on the subject, it is neither a résumé nor an encyclopædia, but it treats each of the several topics presented with sufficient fulness to meet the requirements of most of those whose practice calls them into court as witnesses or attorneys. All of the con-

tributors—for the work is composite—are men recognized as authorities in their respective lines of knowledge and usefulness. The introduction by the editors deals with expert evidence, and gives sound advice to medical experts and valuable suggestions to attorneys. The topics treated include the technique of medico-legal post-mortem examination; identity; the signs of death; sudden death; death from cold, heat, starvation, asphyxia; death and injuries by lightning and electricity; wounds, gunshot wounds, burns, and scalds; the destruction and attempted destruction of the human body by fire and chemicals; railway injuries; injuries and disorders of the nervous system following railway and allied accidents; the medical jurisprudence of life insurance and accident insurance; medico-legal aspects of vision and audition; speech disorders; inebriety; the stigmata of degeneration; insanity, idiocy, imbecility, and feeble-mindedness, and mental perversions of the sexual instinct. The writers include such well-known authorities as Drs. Ludvig Hektoen, James Ewing, Allen J. Smith, Ely Jelliffe, Lewis Balch, Josiah Newhall Hall, Walter S. Haines, J. Chalmers Da Costa, Pearce Bailey, S. T. Armstrong, Edward Jackson, Frank Warren Langdon, Graeme M. Hammond, Frederick Peterson and J. T. Eskridge. It will be noted that this volume does not touch on toxicology, and covers only a portion of the general subject of forensic medicine.

It would be impossible within the ordinary limits of review to do justice to the many very excellent qualities of this volume. Each chapter holds the interest of the reader throughout, and is presented with great clearness. The reviewer has no hesitation in saying that the work is one of the very best that has been produced in the English language, and reflects great credit both on the writers and the publishers. The illustrations and presswork are excellent and the index very complete. C. H.

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THE PRACTICAL MEDICINE SERIES OF YEAR BOOKS. Vol. V., "Obstetrics." Edited by REUBEN PETERSON, A.B., M.D., Professor of Obstetrics and Gynecology in the University of Michigan. Chicago: The Year Book Publishers.

THE present volume, one of a series issued monthly with the purpose of covering the work of the year in medicine and surgery as portrayed in the literature, is deserving, as its predecessors have been, of much praise for the manner in which it has fulfilled its mission.

The idea of this series is to present a bound volume of abstracts of the important articles which have appeared recently, thus enabling readers to obtain a view of the whole field, and placing them in a position to investigate further along special lines as their individual needs and inclinations may prompt.

There are no comments upon the views expressed by the authors abstracted, as the editor feels that no good purpose could be obtained by such a course. This seems rather unfortunate to us, since the views of the editor would act as a corrective in certain cases; but the reason given for his abstaining is valid, since the size of the volume would not permit an expression of his opinion as regards every paper, and unless this were done he would tacitly give consent to all articles not criticised. W. R. N.

REPORT OF STREAM'S EXAMINATION, CHEMICAL AND BACTERIOLOGICAL, OF THE WATERS BETWEEN LAKE MICHIGAN AT CHICAGO AND THE MISSISSIPPI RIVER AT ST. LOUIS FOR THE PURPOSE OF DETERMINING THEIR CONDITION AND QUALITY BEFORE AND AFTER THE OPENING OF THE DRAINAGE CHANNEL. MADE UNDER THE DIRECTIONS OF ARTHUR R. REYNOLDS, M.D., Commissioner of Health, City of Chicago. Published by authority of the Trustees of the Sanitary District of Chicago, December, 1902.

IN May, 1889, the Chicago Sanitary District was created for the diversion from Lake Michigan of the sewage of Chicago and its inoffensive disposal toward the Gulf of Mexico, whereby further pollution of water along the city front would be prevented, and, incidentally, the "malaria preserves" along the Illinois River would be reclaimed, and navigation between Lake Michigan and the Mississippi River improved. The Sanitary Drainage Channel, which was constructed for these purposes at an expenditure of $36,000,000, was opened in January, 1900, but long before it was finished the city of St. Louis had threatened to appeal to Federal authority to prohibit its use, on the ground that the sewage from Chicago would ruin the St. Louis water supply. Accordingly, Dr. Arthur R. Reynolds, the Commissioner of Health, urged upon the Board of Trustees of the Sanitary District of Chicago the desirability of an exhaustive series of examinations, both chemical and bacteriological, of the waters between Lake Michigan at Chicago and the Mississippi River at St. Louis, in order to determine their condition and quality before the completion of the channel and for comparison with their condition and quality under the dilution to be afforded by the channel. It was suggested that duplicate samples should be offered to the St. Louis authorities for examination in their own behalf, on the assumption that the opposition to the channel had an honest animus. Arrangements were made to have the examinations made at the University of Chicago, the University of Illinois, and the laboratory of the city of Chicago. The authorities of St. Louis were invited to take part in the investigation, but did not reply. The investigation was conducted by Dr. Gehrmann, of the City Laboratory; Professors Palmer and Burrill, of the University of Illinois; and Professor Jordan, of the University of Chicago, on a plan of great magnitude; and their results, which are given in great detail, make this very useful and instructive report, comprising 140 pages plus 195 full-page tables. Briefly, the result of the work is this: The charge that Chicago sewage injuriously affected the drinking water at St. Louis is completely and effectually disposed of. All evidence that typhoid bacteria or other pathogenic organisms are likely to pass from Chicago to Grafton, above St. Louis, in the water of the Illinois River, was negative, and a study of the death rate among the colon bacteria added to the river water in sewage indicates that typhoid bacteria are not likely to survive passage down river. The colon bacilli disappear almost completely in less than 150 miles flow, and since they are more hardy than the typhoid bacillus, it is submitted by Jordan that there is every reason to believe that this organism dies out with, at least, the same rapidity. Moreover, while typhoid bacteria were found in the water at the mouth of the Illinois, there are scores of communities to which they might be traced more plausibly than to Chicago. Professor Burrill agrees that it is very clear that

Chicago sewage cannot be held responsible for contaminations existing in the commingled waters of the Mississippi and Missouri Rivers, and Professor Palmer's report is also to the same effect. The volume is one which will be read with great interest by all who are interested in water supplies and sewage disposed by water carriage. C. H.

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UEBER DAS MALIGNE CHORIONEPITHELIOM UND DIE ANALOGEN WUCHERUNGEN IN HODENTERATOM. By W. RISEL, Arbeitem aus dem pathologischen Institute zu Leipzig. Leipzig: Herausgegeben von F. Marchand, Hirzel, 1903.

IN this monogram of 170 pages Risel presents a very complete study of "deciduoma," or, as he prefers to call it, "chorionepitheliom," and of the analogous development sometimes seen in teratomata of the testicle. The literature, comprising 131 references, is most thoroughly analyzed, and the writer's conclusions are based in part upon the results of this analysis and in part upon his own studies. Six new cases of deciduoma are described, and the result of the study of the metastases of a previously reported (Menge's) case is also given.

Of the six examples, two developed after abortion, one without metastases, the other with extensive secondary involvement of practically all organs except the spleen. The remaining four cases were associated with uterine mole. In one there was no dissemination, while two were accompanied by metastases. The fourth belonged to the interesting group in which multiple metastases are found in the absence of a primary tumor of the uterus; the mucosa of the latter, however, being transformed into decidual tissue.

In describing the histological character of this tumor, Risel uses the terms "typical" and "atypical," first introduced by Marchand. The former indicates a tumor in which is preserved the character of chorionic epithelium as seen in the early periods of pregnancy (symmetrical masses in irregular, multinucleated, branching processes with more or less prominently developed polyhedral decidual cells). The latter term indicates that this regular arrangement is more or less lost, the cells isolated, altered in form, and differing in their staining characteristics. The distinction, however, is not always easy, owing to the occurrence of transitory stages. Of special interest are the observations upon the development of metastases of the skin; the ready penetration of the uterine vessels by tumor processes, thus explaining the secondary growths, and the relation which the new-growth has to fibrin formation and the destruction of the invaded tissues.

Two cases are described in which after abortion and curettage an extensive development of chorionic, epithelium-like tissue occurred, without, however, displaying malignant tendencies.

From an analysis of the literature and the study of two specimens, Risel comes to the conclusion that although cell formations resembling chorionic epithelium may occur in teratoma of the testicle, there is no proof that they arise from included fetal membranes. Their origin is apparently from the fetal ectoderm, and they are of the same importance as other ectodermal structures of teratomata.

The work is illustrated by two figures in the text and by three plates.

D.

# PROGRESS

OF

# MEDICAL SCIENCE.

## MEDICINE.

UNDER THE CHARGE OF

WILLIAM OSLER, M.D.,

PROFESSOR OF MEDICINE IN THE JOHNS HOPKINS UNIVERSITY, BALTIMORE, MARYLAND,

AND

W. S. THAYER, M.D.,

ASSOCIATE PROFESSOR OF MEDICINE IN JOHNS HOPKINS UNIVERSITY, BALTIMORE, MARYLAND.

**A Statistical Study of the Intestinal Parasites of 500 White Male Patients at the United States Government Hospital for the Insane.**—GARRISON, RANSOM, and STEVENSON (*Hygienic Laboratory, Public Health and Marine Hospital Service of the United States, Bulletin No.* 13) recently published the results of the examinations of the stools of 500 white patients in the Government Hospital for the Insane at Washington, with the object of determining the frequency of intestinal parasitic infection. Parasites were present in 66 (or 13.2 per cent.) of the cases. Ten patients had a double infection, and in one case three different parasites were present, making a total of 78 infections. The uncinaria americana, or anchylostoma duodenale (hook worms) was present in 15 cases, or 3 per cent.; the trichuris trichiura (whip worms) in 54 cases, or 10.8 per cent.; the oxyuris vermicularis (seat worms) in 4 cases, or 0.8 per cent.; the strongyloides stercoralis (Cochin-China worms) in 3 cases, or 0.6 per cent.; the ascaris lumbricoides (eel worms) in 2 cases, or 0.4 per cent. No tape worms, flukes, or coccidia were found. No evidence of parasitic infections of the liver, stomach, lungs, or other organs was present. The largest number of infections occurred in the men who had returned from service in the Philippines. Of 59 of these, 25, or 42.46 per cent., had intestinal parasites. There were 10 infections with hook worms, 23 with trichuris, 1 with strongyloides, and 1 with ascaris, or a total of 35 infections. The percentage of infections in these men was more than twice as high as in any other group. The writers emphasize the danger the returned Philippine soldier is to the general public, owing to the risk of spreading the uncinaria infection in districts not previously infected. The

parasites apparently had but little influence on food digestion, nor did they influence the reaction of the feces.

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**The Occurrence of Gout in the United States.**—After referring to the general belief that gout is of infrequent occurrence in the United States, and quoting several English authorities supporting this view, FUTCHER (*Practitioner*, July, 1903, p. 6) proceeds to show that this belief is quite erroneous. This is done by comparing the number of cases of gout admitted to the medical wards of the Johns Hopkins Hospital for a period of fourteen years with the number admitted for the same period to St. Bartholomew's Hospital, a general hospital in Southern England, where gout is conceded to be more prevalent than anywhere else in the world. In the former institution for this period there were 41 cases of gout, or 0.26 per cent. of the total number of medical patients, while in the latter there were 124 cases of gout, or 0.37 per cent. of the medical cases. The ratio of gout admissions to the two institutions was practically two to three. In other words, the frequency of gout in a general hospital in London is only one-third greater than in a similar institution in Baltimore, and there is no reason to believe that the disease is more frequent in Maryland than elsewhere in the United States.

In the majority of the cases the disease was acquired rather than inherited. Alcohol, in the form of fermented spirits, and lead were the most potent etiological factors. All of the patients were males, and with one exception whites. Thirty-two of the patients were native-born Americans. In 39 the disease had reached the chronic stage, and in 19 tophi were present.

Arteriosclerosis was evident in 29 cases. The majority of the cases showed signs of nephritis of an interstitial type. Albumin was present in 32 and hyaline or granular casts in 26 instances. There were 4 cases of gouty bursitis, 1 of parotitis, 1 of pericarditis, and 1 of retrocedent gout, with symptoms simulating intestinal obstruction.

The difficulty of differentiating the disease from articular rheumatism in the early stages was illustrated by the fact that four of the cases were repeatedly diagnosed as the latter on their early admissions, the appearance of tophi containing characteristic acicular crystals of biurate of soda, later revealing the true nature of the disease. The series illustrated the importance of examining the ears and the vicinity of the joints for the presence of tophi in all cases of multiple arthritis of doubtful origin.

The opinion is expressed that the apparent infrequency of gout in the United States is due in large part to the failure on the part of physicians to recognize the disease.

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**Lipæmia in Diabetes Mellitus.**—FRASER (*Scottish Medical and Surgical Journal*, September, 1903, p. 200) reports an instance of lipæmia in a fatal case of diabetes mellitus in a boy, aged seventeen years. The patient died of typical diabetic coma. The lipæmia was recognized several weeks before death. A microscopic examination of the blood showed the plasma to contain innumerable fine granulations, exhibiting a rapid, oscillatory, "Brownian" movement. After standing for an hour the preparation showed clear refractile droplets less than half the diameter of a red blood corpuscle. These droplets stained black with perosmic acid, and red with Soudan III.,

demonstrating their fatty nature. Ophthalmoscopic examination of the eyes showed the retinal vessels to have an opaque white color. Death was ushered in by characteristic "air hunger," and the urine contained large amounts of acetone and diacetic acid.

The heart's blood, removed at autopsy and allowed to stand, separated into a lower dark purplish-red coagulum and an upper pale reddish-brown turbid serum, at the bottom of which was a creamy white layer of fat. The cavities of the pleura, pericardium, and peritoneum, as well as the subdural space, contained a large quantity of milky fluid. The vessels on the surface of the brain contained a distinctly milky-looking fluid which evidently displaced the blood. This milky fluid was irregularly distributed. The vessels of all the organs, including the lungs, contained a similar milky fluid. Sections of the various organs stained with hæmatin, perosmic acid, and Soudan III. clearly demonstrated that this milky fluid was fat. There was no marked fatty degeneration in any of the tissues, this being most extensive in the liver.

An analysis of the blood taken from the femoral artery showed 16.44 per cent. of fat, and that of the pleural exudate 18.94 per cent. When one considers that normal blood, according to the numerous analyses of Becquerel and Rodier, contains only from 0.16 to 0.325 per cent. of fat, and the blood of ordinary uncomplicated diabetics, according to Schmidt and Röhring, only from 0.18 to 0.5 per cent., it can be appreciated what an enormous increase there was in this case. In only one instance has this high percentage of fat in the blood been exceeded. Fischer has quite recently reported a case of diabetic lipæmia in which the blood contained 18.129 per cent. of fat.

An excess of fat in the blood of diabetics was noted as early as 1799 by Mariet, of Edinburgh. Special interest was attached to its occurrence in 1879, when Sanders and Hamilton advanced their theory that diabetic coma was due to fat embolism of the cerebral and pulmonary vessels. Fraser supports the generally accepted view that fat embolism is not the cause of the coma. The writer does not think that the fat in these cases is derived from that resulting from fatty degeneration of the viscera. Nor does he believe that it results from an accumulation of the normal fat in the blood owing to defective lipolysis. He points out the significant fact that in his case and in cases reported by other observers the appearance of coma and lipæmia are coincidently, or nearly coincidently, associated with a marked reduction in the quantity of sugar in the blood and urine. He intimates that by means not yet understood the sugar may undergo transformation into fat, a physiological process illustrated by the transformation of sugar into beeswax, as pointed out by Halliburton. He further states that in accordance with the amount of this fat in the blood the solvent capacity of the serum for oxygen would become reduced, and that thereby the death-producing power of the existing acidosis would be reinforced. The writer urges the importance of early recognizing the existence of an acid intoxication and a lipæmia by frequent examinations of the urine and blood. While the lipæmia in itself is not a source of great danger, both are probably dependent on the same factors. He insists on the necessity of commencing the alkaline treatment early when the urine indicates the existence of an acid toxæmia or acidosis.

# SURGERY.

UNDER THE CHARGE OF

J. WILLIAM WHITE, M.D.,

JOHN RHEA BARTON PROFESSOR OF SURGERY IN THE UNIVERSITY OF PENNSYLVANIA; SURGEON TO THE UNIVERSITY HOSPITAL,

AND

F. D. PATTERSON, M.D.,

SURGEON TO THE X-RAY DEPARTMENT OF THE HOWARD HOSPITAL; CLINICAL ASSISTANT TO THE OUT-PATIENT SURGICAL DEPARTMENT OF THE JEFFERSON HOSPITAL.

**Clinical Remarks on the Results of Operations for Strangulated Hernia.**—Barker (*Lancet*, May 30, 1903) reports the results of an analytical study of 406 consecutive cases, treated in the University College Hospital, London. It is of interest to note that the number of cases operated on for strangulated hernia in this hospital has gone on steadily rising, and for the last ten years the average number has been just twice as great as twenty years ago. This is partly due to the fact that reduction by taxis is now less frequently resorted to in severe cases than formerly, but not entirely. As to the diminution in the number of cases admitted into the wards for strangulation and there treated by taxis, it may be stated that in the first series of years taken 36 were so treated by taxis, in the second equal number of years 52, in the third only 19, in the fourth only 6, and in the last none at all. But though strangulated hernia may possibly not decrease in frequency there is happily every prospect that the ill effects which result from it may diminish in severity as its dangers are more fully recognized and more intelligent and common-sense measures are adopted to meet them at an early moment. This condition is common to all classes as well as being found in all classes. The mortality in the cases treated by taxis has been so high (13.8 per cent. in the first series and 13.4 per cent. in the second equal series) that there is grave doubt whether, in any given case of strangulated hernia, taxis ought ever to be employed except in the very recent cases and among aged patients in a state of great weakness. The actual duration of the strangulation has been shown to be an unsafe guide as regards the propriety of replacing the loop in the abdomen.

Leaving quite apart the cases in which taxis has been applied, the cases that have required operation show a very high rate of mortality, and this in spite of all our improvements in surgical theory and procedure. Of the 406 cases 127 died, or a mortality of 31.2 per cent.; but when this is further analyzed the result is better than at first appears, for in the first series of years the mortality was 53.1 per cent., while in the last series it is only 22.2 per cent. A careful consideration of the mortality table shows that about 100 of these cases died from trouble depending upon the state of the bowel returned. In other words, if it had been possible to treat these cases without returning the gut there would probably have been a much lower death rate. During 1903 seven cases of this character were treated by enterectomy, with

four deaths, and it is quite sure that each of these patients who recovered would undoubtedly have died had the bowel been returned to the abdomen in the condition in which it was found. Along these lines lies the hope for a further reduction in the mortality of operation for the relief of strangulated hernia.

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**Some Observations on Movable Kidney.**—GORDON (*Lancet*, June 6, 1903) states that it is now well recognized that movable kidney is a cause of various and diverse symptoms—that it may induce vomiting and other gastric manifestations, jaundice and hepatic colic, or symptoms which belong to the kidney itself, and that it may be associated with a neurasthenic condition. With such diversity of symptoms, it can readily be understood that movable kidney is a common cause of mistaken diagnosis. There are two facts which, when fully realized, ought to safeguard one against error to some extent. First, it should be remembered that movable kidney is of exceedingly common occurrence and often is the sole cause of some of the symptoms which have been mentioned. In the second place it should still more carefully be borne in mind that the movable kidney, whatever degree of mobility it may possess, may be a cause of no symptoms. One may conveniently arrange these cases which cause symptoms into certain groups as follows: (1) Those with slight discomfort, such as dragging sensation and associated with vague general ill health, with or without hysterical manifestations. (2) Those in which the symptoms are of the gastrointestinal type. (3) Those with hepatic symptoms. (4) Those having distinctly renal symptoms, which must be very uncommon. The author, after reporting in detail seven cases illustrating these groups, states, in conclusion: (1) That in neurasthenic cases nephropexy may do good. (2) Vomiting and other gastric symptoms can certainly be cured, but if dilatation of the stomach is present a guarded prognosis must be given. (3) Movable kidney is not the only cause of obscure abdominal symptoms, as has been shown in a case of mistaken diagnosis. (4) Movable kidney occasionally causes symptoms which exactly simulate those due to gallstones, but seeing that the coincidence of movable kidney and gallstones is not uncommon, it would be unwise merely to fix the kidney without a preliminary examination of the gall-bladder and ducts. Finally, whilst readily granting that most cases of movable kidney cause no symptoms, and therefore require no operation, there remain many which do cause symptoms, and in a fair proportion of these an excellent result from nephropexy may confidently be anticipated.

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**The Treatment of Enlarged Prostate.**—HEATON (*Birmingham Medical Review*, June, 1903) states that Sir Henry Thompson has estimated, from a large number of post-mortem examinations made on male adults over the age of sixty, that the prostate was enlarged in 34 per cent of such patients, but that it did not cause symptoms during life in more than 15 or 16 per cent. The main indications for operation may be stated as follows: (1) When, after a longer or shorter period of catheter life, the difficulty in the passages of the instrument is becoming greater and greater, and its use is becoming necessary at shorter and shorter intervals. (2) When the enlargement of the gland, as determined by examination per rectum and by means

of the cystoscope, is chiefly an enlargement of the middle lobe, producing a valvular obstruction to the outflow of urine. (3) When the bladder has been opened for complete retention, and the patient's condition is sufficiently good to give him a reasonable chance of standing the major operation. (4) When enlarged prostate complicates vesical calculus. (5) When the patient's strength is being undermined by want of sleep and pain from repeated catheterization, or when the introduction of the catheter is always followed by hemorrhage. (6) After repeated attacks of acute inflammation of the enlarged organ.

*Treatment.* Double castration was introduced to the profession by Dr. J. William White in 1893. As compared with the operations of complete or partial prostatectomy it seems to have the following advantages: (1) That of a considerably lower mortality. The mortality of double castration, when performed upon patients who are not actually *in extremis*, is probably not more than 8 or 9 per cent. (2) The operation is speedier, accompanied by less shock and less reflex effect on the kidneys if they are already diseased. (3) There is practically no risk of hemorrhage; whereas, in the operation of prostatectomy the hemorrhage may be most severe, and, indeed, be indirectly the cause of the patient's death. (4) The period of confinement to bed and convalescence is much shorter. The objections to the operation are the sentimental objection upon the part of the patient to the loss of the organs. The removal of both testicles does not seem to produce the same effect upon all enlarged prostates. When the enlargement is a pure hypertrophy, or contains a good proportion of glandular element in it, the diminution in size is generally marked and more often rapid. But if the enlargement be more fibrous, and the gland be cleaner and harder than normal, the diminution is apt to be much less, and in consequence the benefit due to the operation less marked. Rarely cerebral complications have been known to follow this operation. If the inability to empty the bladder be due to muscular atony of its wall, little or no benefit will accrue from any radical operation.

The author reports five cases treated by this method, all of which were improved by the operation. As regards the statistics of this operation White, in 1895, collected 111 cases, with a mortality of 18 per cent. In 87 per cent. of those that recovered there was more or less atrophy of the prostate, and in 46 per cent. the local conditions became almost normal, while the more troublesome symptoms returned in 13 per cent. Wood has collected 159 cases with 13 deaths, and in 16 the result is not stated. Of the remaining 130 cases the prostate decreased in size in 51.5 per cent., and in 57 per cent. the function of micturition was either improved or wholly restored.

Vasectomy has been urged as a substitute for castration, and Harrison has reported a series of 100 cases where some benefit apparently followed in every case. Wood has made an analysis of 193 cases and found the death rate to be 6.7 per cent. Of the cases that recovered from the operation there was some improvement in 15 per cent., and residual urine diminished or disappeared in 5 per cent., but in 15 per cent. no improvement whatsoever followed. It would, therefore, seem that the operation has nothing to commend it as a substitute for castration save its lower mortality, and its results are too uncertain at present to justify us in advising our patients to undergo it, save when castration is objected to.

Suprapubic prostatectomy. Freyer has published the results of 21 operations by this method, with 2 deaths. In the other 19 cases a good result was obtained.

## THERAPEUTICS.

UNDER THE CHARGE OF

REYNOLD WEBB WILCOX, M.D., LL.D.,

PROFESSOR OF MEDICINE AND THERAPEUTICS AT THE NEW YORK POST-GRADUATE MEDICAL SCHOOL AND HOSPITAL; VISITING PHYSICIAN TO ST. MARK'S HOSPITAL,

AND

SMITH ELY JELLIFFE, M.D., PH.D.,

PROFESSOR OF PHARMACOGNOSY AT THE COLLEGE OF PHARMACY; INSTRUCTOR IN MATERIA MEDICA AND THERAPEUTICS (COLUMBIA UNIVERSITY), NEW YORK.

**A New Tetanus Treatment.**—Dr. J. MACFARLAND, of Philadelphia (*Journal of the American Medical Association*, 1903, vol. xli., No. 1, p. 34), describes a dry antitetanic powder suggested by Prof. Calmette at Lille. This observer showed that antitetanic serum is readily absorbed by denuded surfaces, and thus taken in can confer immunity on animals. MacFarland then combined a harmless antiseptic with a dry antitetanic serum, resulting in an antitetanic powder. This antitetanic powder demonstrated that it could confer immunity on susceptible animals.

**X-ray Therapy in Enteritis and Colitis.**—Dr. SINCLAIR TOUSEY (*New York Medical Journal*, July, 1903, vol. lxxviii., No. 2, p. 73) has been making some experiments on the treatment of chronic conditions of pain or discomfort in the intestines, with frequent discharge of mucus and occasionally discharges of blood and false membrane, and which have failed to yield to the use of intestinal antiseptics given by mouth and to other antiseptics given by enteroclysis. He has made applications by having the patient lie flat on an examining table, exposed, and with an X-ray tube about eight inches from the surface, and the light directed principally toward the region where the pain is felt. The first exposure lasts from three to five minutes; later the exposures may be greatly increased in duration. The improvement in the few cases which have come under treatment, he says, may be due to the novelty of the procedure. Any expectation of lasting benefit may be interpreted along the lines of the well-known stimulating and alterative effect of the X-ray upon the tissues rather than to its bactericidal action.

**The Nernst Lamp in Therapeutics.**—Dr. WM. RAWLINS, of Boston (*Boston Medical and Surgical Journal*, 1903, vol. cxlix., No. 2, p. 37), suggests the use of the Nernst lamp instead of other forms of electrical apparatus now used in light therapeutics. He says that the ether wave is extremely short, and that there is no glass covering and there is no absorption. He says the light is well suited for use in therapeutic cabinets in which an even distri-

bution of radiant energy is desired, and heretofore obtained by using many incandescent bulbs. Another advantage he holds is that the consumption of current for the same number of light waves is greater, less of the current being converted into heat waves.

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**Cause and Treatment of Gout.**—Dr. ALEXANDER HAIG (*Practitioner*, July, 1903) presents some modifications of his uric acid theory as to the causation of gout, coming to the following conclusions: (1) That gout is due to poisoning by flesh and tea and similar substances, which introduce uric acid into the body in very considerable quantities. (2) That the uric acid so introduced may not only remain in the body, but may prevent the excretion of the uric acid formed in the body. (3) That as a result the tissues of the body become more or less saturated with uric acid, which may irritate its fibrous tissues (gout or rheumatism), or may obstruct its capillaries, causing high blood pressure and defective capillary circulation and their results, such as the great group of circulation diseases, the uric acid headache, epilepsy and mental disease, anæmia, Bright's disease, Raynaud's disease, etc.—all of them being mere results of the enormous influence which uric acid exerts on the circulation of the body by obstructing its capillaries. (4) That all these troubles which have been called by so many names fall into two groups—(*a*) the local group and (*b*) the circulation group—of which the latter is by far the more extensive and important, so that what we formerly called gout and rheumatism become almost insignificant by comparison. In the future they will all, he hopes, be called uric acid poisoning, and be recognized as due to poisonous or unnatural food.

So far as treatment is concerned, he says "that in acute cases with fever the indication is to give a solvent, and that the best solvent is a salicylate, either in the form of salicylate of soda or salicylic acid, or, perhaps better than either, aspirin; and to give this in sufficient quantity, not less than a drachm a day, and often more than this, up to the ordinary doses given in acute rheumatism. In chronic arthritis without fever, but without debility, the same drugs may be given, although care must be taken to feed up, to give a certain amount of acid, to keep the patient cool, and to give some tonics. In very chronic arthritis, with marked debility and anæmia, the first thing to do is to give tonics and to feed up on any food without the least regard to uric acid; and when the patient has been got into a condition of good nutrition by these means, salicylates in one of the above forms may be given with advantage. Where there is marked debility with acidity of the urine, they should certainly not be given at first; and, as he has pointed out, many of these cases of arthritis with debility improve very greatly by feeding up and tonics, because these clear the blood of floating uric acid, and thus put a stop to the "uric acid filter" action, which was the cause of the chronic trouble. In these conditions, associated with debility, drugs that put a stop to collæmia may produce a more or less acute arthritis as they clear up the collæmia. If they do this, and if there is with the arthritis a rise of temperature, then it would be right to treat the arthritis with salicylates, just as in the cases which are acute from the beginning. But it is a very interesting experience to watch the effect of giving, say, a metal which forms an absolute compound with uric acid and drives it out of the blood

into the fibrous tissues or joints, producing the whole series of changes above described in the blood and circulation and in the urine, which may be easily observed as they pass before you. The patient will then say that he has had a relapse of his gout, and one will know why he has had it, and also exactly what it is necessary to do to prevent all future similar relapses.

The many errors and misunderstandings that have arisen as to the etiology and pathology of arthritis and collæmia, or the local group and the circulatory group of uric acid poisonings, have for the most part been due to the original errors and erroneous conclusions of those physiologists and experimenters who worked without any regard to the solubility of uric acid in the blood and tissue fluids of the body. If these experiments had never been made it would have been seen much more quickly, what is known to-day, that these things are not diseases at all, but mere symptoms of food poisoning, and that the poisons being left out the symptoms cease to appear.

When this has become common knowledge it will be obvious that the "uric acid diathesis" is a myth, and that gout is but a symptom of poisoning by flesh and tea; while, lastly, this complete and correct knowledge will give complete power over the symptoms, and enable the removal of all results except the larger structural lesions which the food poisons may have produced.

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**Injections of Calomel.**—Dr. M. DANLOS (*Les nouveaux remèdes*, 1903, vol. xix., No. 9, p. 103) presents a note on two modifications of the usual formulæ for the injection of calomel that he has found useful in the treatment of rebellious cases of tertiary syphilis. It has been found by many syphilographers that these obstinate cases of tertiary syphilis have been greatly benefited by injections of calomel, but occasionally there are patients who resist even this remedy when used in the old form. The use of oily vehicles to suspend the calomel is open to much criticism. Vaselin, which is largely used, dissolves calomel very slowly and favors the formation of nodes, which engulf the salt and prevent its action. Water does not hold calomel in suspension. Emboli are apt to form, and, moreover, portions of the drug remain in the syringe. Glycerin, gum, and syrup have been used. Glycerin, however, has been found to be painful, and the gums are difficult to sterilize. The author has made some experiments with the use of sugar, which vehicle he has found of great service. The sugar and the calomel are sterilized separately. The mixture is made in a sterile flask, and injections are made with this sterilized product.

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**New Salts of Mercury for Injections.**—Drs. L. JULLIEN and F. BERLIOZ (*Les nouveaux remèdes*, 1903, vol. x., No. 10, p. 223) have obtained and have studied several new soluble salts of mercury for the treatment of syphilis. They have combined a cacodylate of ammonium with an oxide of mercury, forming a mercurial cacodylate, which results in a gray powder very soluble in water, containing at least 56 parts of mercury in 100. In tests on at least fifty patients a dose of $\frac{1}{6}$ to $\frac{1}{4}$ of a grain has been very well borne. Another salt, the ammonium-chloro-mercurate, is made by dissolving the yellow oxide in the solution of ammonium chloride. This seems to be better borne than corrosive sublimate, although it has been found at times that injections are painful. The dose is the same as sublimate.

# OBSTETRICS.

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE; PROFESSOR OF OBSTETRICS AND DISEASES OF INFANCY IN THE PHILADELPHIA POLYCLINIC; CLINICAL PROFESSOR OF DISEASES OF CHILDREN IN THE WOMAN'S MEDICAL COLLEGE; VISITING OBSTETRICIAN TO THE PHILADELPHIA HOSPITAL, ETC.

**Tubal Gestation.**—In the *Scottish Medical Journal* of April, 1903, KYNOCH reports the case of a patient whose menstruation had been delayed one week, followed by a continuous hemorrhagic discharge. She had passed two large pieces of membrane. The uterus was movable and slightly enlarged. Posteriorly and to the right of the uterus there was a fixed tender swelling about the size of a finger. After four weeks, during which the patient had intermittent pain and hemorrhage, operation was performed. The right Fallopian tube was distended and both were adherent. The tube contained a sac with villi. Eighteen months previously this patient had symptoms of ectopic gestation on the opposite side, ending in the formation of a hæmatoma of the left broad ligament.

Case II. was a multipara who had suffered from ovaritis on the left side. Menstruation was delayed for six weeks, and she had had much pelvic pain. There had been an abundant red discharge. On examination, the uterus was slightly enlarged, with tenderness on both sides, and to the right and behind an enlargement of the size of the finger. Upon operation the right Fallopian tube, which was enlarged and adherent, and the ovary were removed. On opening the tube it contained a blood clot with a cavity lined with a smooth membrane containing a reddish fluid. There was no trace of embryo.

His third case complained of pain on the right side, with an enlarged uterus and a tender swelling to the right and behind it. On examination under an anæsthetic something was felt to give way under pressure. The patient had shock and showed signs of hemorrhage. When the abdomen was opened a large quantity of blood was present and a rupture in the right tube. The tube and ovary were removed, the abdominal cavity irrigated, and strychnine was given. The tube was filled with blood clot containing a sac, whose walls showed villi. No embryo was found.

He also reports a case in which he suspected tubal gestation, but which proved to be a threatened abortion. The patient discharged twin ova soon after examination.

Kynoch also reports the case of a patient from whom he had removed an ovarian cyst upon the right side. After menstruation had been absent for two months the patient complained of pain. There was a round, tender swelling about the size of an egg behind the uterus. On opening the abdomen the left tube was found to be thickened and the ovary adherent. Both were removed. The ovary consisted of a small cyst filled with dark, tarry blood. The tubal swelling was found to be tuberculous. In this case hemorrhage into a cystic follicle caused pain resembling that of ruptured ectopic gestation.

Hydrosalpinx and cystic ovary may simulate tubal gestation, as illustrated by the following case: The patient complained of intermittent pain in the right iliac region. On examination a tender oval swelling was found on the right side and separated from the uterus. At operation the swelling was found to be a cystic ovary adherent to the tube.

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**Puerperal Insanity.**—JONES (*Transactions of the Obstetrical Society of London*, 1903, part i., vol. lxv.) contributes an extensive paper, giving the results of his experiences in 259 cases of puerperal insanity, of which 120 were during the puerperal period, 83 during lactation, and 56 during pregnancy.

From these cases he concludes that the insanity of pregnancy is more common where the pregnancy is illegitimate and in the first confinement. Acute melancholia with suicidal symptoms was present in 41 per cent. of these cases. During the early months insanity is less acute than when the patient becomes insane just before her labor. The sex of the child has no influence upon the occurrence of insanity.

Puerperal insanity occurs after the first confinement in 33 per cent, and usually develops suddenly. During lactation the symptoms are those of general physical exhaustion, with great depression. It has a tendency to become chronic. Low forms of inflammation, thrombosis, gangrene, and phthisis are seen during the insanity of lactation. Suicidal and infanticidal tendencies are also common where insanity began more than six weeks after labor.

Early symptoms are loss of sleep and headache, which should give warning of mental breakdown. Delirium with hallucination, ending in restless mania, is characteristic of this variety.

Heredity is more pronounced in the maternal line in puerperal and lactational insanity, and is equally pronounced in the insanity of pregnancy. A history of previous hysteria is often given.

The pathology is that of heredity and stress. It is possible that a toxin is present where stress is the important factor.

As regards prognosis, cases of insanity during early pregnancy improve as confinement approaches, whereas those of late pregnancy grow worse during the puerperal state. Recovery often ensues and improvement is often rapid, recovery being complete in from four to five months.

All cases presenting headache and sleeplessness must have absolute rest, and quiet and sleep must be procured. If possible patients should be kept at home, and suicidal and infanticidal impulses must be guarded against. The presence of the patient's husband aggravates the symptoms. The diet should be liberal and stimulating, and change of air and scene is necessary when cases tend to become stuporose. Menstruation is a sign of mental improvement. So far as drugs are concerned iron and purgatives are valuable.

So far as the frequency of childbearing insanity is concerned, statistics show that among private patients about 7 per cent. of those women insane become so during the childbearing period; while among ward patients the percentage rises to 8 or 10. It is estimated that one case of insanity occurs for each 1100 births. Other authorities state that the ratio may vary from 1 in 400 to 1 in 700.

# GYNECOLOGY.

UNDER THE CHARGE OF

HENRY C. COE, M.D.,

OF NEW YORK.

ASSISTED BY

WILLIAM E. STUDDIFORD, M.D.

**Sterility Due to the Male.**—BALIN (*Zentralblatt f. Gynäkologie*, 1903, No. 26) examined the semen of the husband in 200 cases of sterility in which no cause could be found in the wife. His conclusions were as follows: (1) In 36.5 per cent. there was azoöspermia, and in 19 per cent. oligonekrozoöspermia. (2) Of the cases of azoöspermia, 63.3 per cent. were due to gonorrhœa acquired before marriage. (3) In over one-half of the cases the husband was suffering from the disease at the time of marriage. (4) Latent or manifest gonorrhœa is the most frequent cause of sterility.

**Gastric Disturbances Due to Pelvic Lesions.**—LIOPET (*Lyons Thesis;* abstract in *Zentralblatt f. Gynäkologie*, 1903, No. 26) affirms that statistics show that over 90 per cent. of women with pelvic trouble suffer from gastric disturbances. The cause is either reflex or mechanical, the latter being due to adhesion of the omentum to the inflamed uterus and adnexa, thus causing traction on the greater curvature of the stomach, gastroptosis, and even a bend of the duodenum. The first class of cases is to be treated on general principles, the latter by laparotomy and separation of the adhesions. Drainage should, of course, be avoided.

**Adenomyoma of the Uterus.**—FÜTH (*Zentralblatt f. Gynäkologie*, 1903, No. 21) reports at length the case of a virgin, aged thirty-four years, who entered the hospital with a tumor the size of the fist, which grew from the lower uterine segment posteriorly and perforated the vaginal fornix, where it appeared as an ulcerating mass, bleeding easily. The diagnosis of cancer was made, and the uterus and upper part of the vagina were extirpated by the abdominal route. Although the broad ligaments were infiltrated, the adnexa and pelvic glands were not involved. On account of the firm attachment of the neoplasm to the rectum, portions were left behind on the wall of the gut. The patient made a good recovery and was free from recurrence nine months after operation.

Microscopically the tumor showed a myomatous tissue filled with glandular structures. No invasion of the uterine or vaginal mucosa was noted. In one ovary, which was adherent to the mass, the same glandular ingrowths were found. The writer infers that the glandular element was derived from Müller's ducts. He discusses the question of malignancy, referring to cases in which Recklinghausen, Rolly and others found a transition to adenocarcinoma, and suggests the name *myoadenoma malignum* as appropriate for his own case.

**Sarcoma of the Uterus in a Child.**—BLUHM (*Archiv f. Gynäkologie*, Band lxviii., Heft 2) reports an interesting case of sarcoma of the cervix uteri in a child, aged eleven years, the only symptom being an occasional slight bloody discharge from the vagina, so that no examination was made for nine months. Vaginal hysterectomy was successfully performed, after making an incision according to Schuchardt's suggestion. The patient made a good recovery, and had no recurrence two months later, though the inguinal glands were enlarged at the time of the operation. The writer argues from this case that, while there are serious objections to making vaginal examinations in children, the persistence of bleeding from the genitals without a history of trauma should at once awaken suspicions of the presence of sarcoma and lead to a careful investigation. Narcosis and, if necessary, incision of the vagina are justifiable. Every cervical polypus in a child should be examined microscopically, since the importance of an early radical operation in sarcoma is self-evident.

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**Gauze Pad in Peritoneal Cavity.**—KAYSER (*Archiv f. Gynäkologie*, Band lxviii., Heft 2) reports a case in which, after removing a piece of gauze which had remained in the cavity for two months, he was obliged to resect the intestine in three places, the patient eventually making a perfect recovery. The writer reports 17 cases in which gauze was left after operation, only one of which terminated fatally. In 9 the foreign body was discharged spontaneously, in 8 removed by operation, but in none were such extensive lesions found as in the case reported.

The writer believes that, although the dangers to be apprehended from the presence of an aseptic pad are much less than those due to other foreign bodies, an attempt should always be made to remove them instead of waiting for nature to expel them, as Boldt advises. (To this list may be added the three cases reported by us, in which pads were removed through the abdominal wound.—H. C. C.)

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**The Function of the Corpus Luteum.**—FRAENKEL (*Archiv f. Gynäkologie*, Band lxviii., Heft 2), from a series of observations at the operating-table and experiments on animals, concludes that menstruation depends directly upon the secretory activity of the corpus luteum, and not upon the pressure of the ripe follicle upon the nerves of the ovary. The corpus luteum is really a gland, secreting a substance which supplies to the uterus the nourishment necessary to preserve its functional activity, and also helps to diminish the climacteric disturbances which are so marked in women whose ovaries have been removed. Hence the importance of preserving the corpus luteum of pregnancy, and of performing ovariotomy only when absolutely necessary and after the fourth month. The writer having inferred that the corpus luteum must contain the active agent, was led to administer the dried substance from non-gravid cows, which he calls "lutein," in doses of four and one-half grains, repeated thrice daily. The indication in a series of fifteen cases were dysmenorrhœa and climacteric phenomena in which flushing, headache, and palpitation were prominent. These were relieved in each instance without any unpleasant effects being noted.

The writer recommends this remedy as being not only superior to oöphorin, but much cheaper.

# PEDIATRICS.

UNDER THE CHARGE OF

LOUIS STARR, M.D.,
OF PHILADELPHIA,

AND

THOMPSON S. WESTCOTT, M.D.,
OF PHILADELPHIA.

**A Mechanical Treatment of Whooping-Cough.**—JACOB SOBEL (*Archives of Pediatrics*, June, 1903, p. 448) calls attention to a method of controlling the paroxysm of whooping-cough, which was first suggested by NAEGELI (*Correspondenzblatt f. Schweizer Aerzte*, 1889, Band xix., S. 417). It consists in pressing forward the lower jaw as is done in anæsthetization. He reports the results of his trial of this method in ninety-six cases, ranging in age from three months to eight years. No selection of cases was made, the children being taken as they came; all grades of severity and all stages were observed. Of this entire number but nine failures were recorded—that is, nine in which the method had absolutely no effect on the paroxysm at the times of the child's visit to the dispensary. In the remainder there never was a time when the reporter could not control the paroxysm and the oncoming whoop by pulling the lower jaw downward and forward. In infants and young children the method seemed less efficacious than in the older ones; they were more easily frightened, and thus the severity of the paroxysm was increased or another precipitated. In some young children, however, it acted remarkably well. In two cases of the series severe epistaxis would occur during a paroxysm; in these the method acted well and the bleeding was controlled.

According to Naegeli this manœuvre is performed somewhat differently according as the operator stands in front or behind the patient. When in front he placed the index and middle fingers on the rami in front of the ear, the thumbs on the chin, and with a forcible but gentle pull and pressure he pushed the lower jaw downward and forward. If the mouth was opened and the tongue extended he placed the thumb or index fingers in the region of the canines, the remaining fingers on the body of the lower jaw, and thus pulled downward and forward. Very frequently he placed only the thumb or index finger back of the lower incisors, the remaining fingers of that hand under the chin, and then manipulated the lower jaw, keeping the other hand on the forehead for counterpressure.

When behind the patient he placed both thumbs against the angles of the jaw, the index fingers on the zygomatic arch, the remaining fingers on the chin, and thus pushed downward and forward; or the index fingers were placed in the mouth behind the canines, and thus aided in the manipulation. When the lower jaw had been raised the patients were directed to take a deep breath (older children).

Sobel has found that a single method answers every purpose. When in front of the child he places the flexed index and middle fingers against the

angle of the inferior maxilla, the thumbs beside the nose, and then pulls downward and forward. If behind the child he places the flexed index and middle fingers against the angle of the jaw, the thumb along its body, the remaining fingers beneath it, and thus manipulates by pulling downward and forward. Naegeli stated that with this treatment the disease assumed a milder character, there was no vomiting, bleeding, or complications due to increased blood pressure, the course of the disease was shortened, and the nights were not disturbed.

Naegeli considered the effect of this manipulation due, first, to reflex action, producing a relaxation of the tonic muscular contraction, and, secondly, to mechanical action, which, by raising the entire larynx and the hyoid bone, elevates the epiglottis, and perhaps opens the rima glottidis. The only contraindication to the use of this method is the presence of food in the mouth or œsophagus.

Sobel thinks it advisable to try this manœuvre in other spasmodic coughs and laryngeal spasms (laryngismus stridulus, pressure of enlarged cervical and bronchial glands, influenza, and glottic spasm in catarrhal laryngitis), though his experience has seemed to show that it is far less efficacious in these conditions than in whooping-cough.

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**A Contribution to the Study of the Summer Diarrhœas of Infancy.**—J. H. MASON KNOX (*Journal of the American Medical Association*, July 18, 1903) gives the results of his investigations in a series of cases of infantile diarrhœa treated at the Thomas Wilson Sanitarium, near Baltimore. Special note is made of the bacteriological findings from the stools, this work having been done by Duval and Bassett. From the stools of forty-two of fifty-three patients, mostly under one year of age, the B. dysenteriæ (Shiga) was isolated.

These were selected cases, in which the stools contained considerable mucus and blood; but later in the summer the stools of twenty-five consecutive cases were carefully examined and the B. dysenteriæ found in nineteen instances. All these latter cases exhibited some form of intestinal disorder.

In order to determine the presence or absence of the bacillus in normal stools the discharges of twenty-five babies, ranging in age from seven weeks to two years, suffering from no intestinal derangement, were subjected to a careful examination. In none of these cases was the Shiga bacillus found.

The technique employed in isolating the organism was essentially that used by Dr. Flexner in the Philippines. The bacilli were studied culturally on the various media, and their agglutination reaction tested with serum from the same patient, the sera from other patients, and with anti-dysenteric serum.

This agglutinating action of the blood serum for the specific organism was a great assistance in the successful isolation, but the technique requires more than usual skill, as far wider variations in the amount of agglutinin in the sera from various patients seem to pertain than in the case of typhoid fever.

The value of the agglutination reaction clinically cannot be asserted as yet positively. The author was able to obtain ten positive results from thirteen cases tested during the first week of illness. As the reaction persists in the chronic cases for weeks or months, it is in this class of cases that the blood tests may prove useful.

In several cases of the series a diagnosis was made on the basis of a positive blood reaction, and a dysentery bacillus was afterward isolated from the stools.

The importance of the finding of this bacillus is evident, as it brings a series of diarrhœal cases in infants into relationship with an organism that is the proven exciting cause of certain varieties of severe intestinal disease in adults.

A detailed account of the series from a clinical aspect is given, and with it the notes of several cases.

In symptomatology and pathology the series differed in no way from the ordinary "summer diarrhœas," and there was nothing to suggest that the cases belonged to an isolated group.

In regard to the method of propagation, the milk served these patients was probably the source of infection, but as the dysentery organism is related biologically to the colon bacillus and the typhoid bacillus, which are usually conveyed to man through water, that very general source of infection must also be suspected.

The majority of the cases of the series were given unboiled city water, and of particular interest were four infants ill with this specific diarrhœa, exclusively breast-fed, but to whom unboiled water was given between nursings.

The author draws the following conclusions:

1. The diarrhœal disorders of a large series of children treated in the Thomas Wilson Sanitarium during the summer of 1902 were produced by a bacillus thought to be identical with the B. dysenteriæ (Shiga).

2. The cases in this series presented the clinical and pathological features of the several forms of the summer diarrhœas of infancy.

3. There is good reason for the confidence that a proportion, and probably a large one, of the so-called summer diarrhœas of infancy is caused by the B. dysenteriæ (Shiga).

4. A confirmation of the work of Duval and Bassett, by establishing the etiology of this yearly epidemic among infants, will make possible the use of more intelligent measures to control and suppress it.

5. More success can be expected from prophylactic measures and from medicinal and serumtherapy than ever before.

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**The Leucocytosis of Measles and of Rubella.**—PLANTENGA (*Arch. de Méd. des Enfants*, 1903, vol. vi. p. 129) has examined the blood in thirteen cases of measles and in nine cases of rubella, and concludes that the leucocyte formula is the same in the various stages of these two diseases.

During incubation there is a decided hyperleucocytosis of the neutrophile polynuclear leucocytes. This is followed during the exanthem by a very marked hypoleucocytosis of these same elements, which, in certain cases, is accompanied by a lymphocytosis at the same time that one finds a general adenopathy of the lymphatic ganglia. After the exanthem the number of leucocytes, if the case is uncomplicated, returns to normal.

In the author's opinion these results confirm the older view that measles and rubella are not two distinct diseases. One can admit, he argues, that the differences in the clinical appearance of these two eruptive fevers are due to different degrees in the virulence of the germs, or to a difference in the port of entry of the infection in the two cases.

[In the light of our present knowledge of the clinical differentiation between measles and rubella, this conclusion, based solely on a similarity of blood reactions in the two diseases, illustrates the danger of too much hæmatology.—ED.].

## PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

SIMON FLEXNER, M.D.,

DIRECTOR OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK,

ASSISTED BY

WARFIELD T. LONGCOPE, M.D.,

RESIDENT PATHOLOGIST, PENNSYLVANIA HOSPITAL.

**Experimental Fat Necrosis.**—WELLS (*Journal of Medical Research*, 1903, vol. iv. page 70) has found that fat necrosis can be produced with constancy, especially in cats and dogs, by intraperitoneal injections of extracts of hog's pancreas or of ordinary commercial pancreatin. Such extracts, moreover, are active either in weak acids, alkalies, or in water. Preparations of carica papaya, or of simple alkaline solutions, did not produce fat necrosis. When the pancreatin was heated for five minutes at temperatures between 65° and 70° C. the power to produce fat necrosis was much reduced, and above 71° C. it was entirely destroyed. These observations pointed to enzyme action as a source of the condition. The exact pancreatic enzyme, which was the cause of the fat necrosis, could not itself be isolated. It was found, however, that trypsin, weak in or devoid of lipase, did not produce this condition, and that, likewise, lipolytic extracts of hog's liver and cat's serum were entirely inactive. Moreover, negative results were obtained with a mixture of pancreatic trypsin and lipolytic extracts of liver. It was not possible to obtain pure pancreatic lipase, so that the action of this enzyme alone could not be studied. Extracts of fresh dog's pancreas, however, which possessed lipolytic power, but which were almost devoid of tryptic power when injected, caused definite fat necrosis; but if to such extracts an emulsion of duodenal mucosa were added, by which means the tryptic activity is greatly increased, no fat necrosis occurred. Thus it appeared that as the pancreatic extracts lost their lipolytic action, their power to produce fat necrosis also diminished; and the author believes it highly probable that the lipase is in some way highly essential to this particular property of the pancreatic extracts. Besides the *intravitam* experiments, many of the features of fat necrosis could be produced with pancreatin in animals after death, and also *in vitro*. The dissemination of the fat necrosis outside the abdominal cavity was sometimes observed as early as twelve hours after intraperitoneal injections, and it was thought that through the lymphatics this spreading was accomplished. From a study of the progressive changes

which took place during the production of fat necrosis it was found that the first alteration consisted in death of the fat cells, while not until later did the fat-splitting occur and the formation of crystalline products appear. The author concludes, therefore, that the fat-splitting is subsequent to and not the cause of the necrosis. The fat necrosis proceeded but for a very few hours at any one point, for the extension seemed to be limited by a zone of leucocytes, the ultimate function of which appeared to be the absorption of the products formed.

Finally, the mere presence of fat necrosis did not seem to be detrimental to the lives of the animals, and healing was possible by a proliferation of the connective tissue from the margins of the areas.—W. T. L.

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**A Contribution to the Pathology of Balantidium (Paramæcium) Coli.**—KLIMENKO (*Beiträge zur Path. Anat. u zur Allg. Path.*, 1903, Bd. xxxiii. p. 281) discusses this subject and describes a case of fatal infection by the balantidium coli. The patient suffered with severe diarrhœa, followed by anæmia. Blood and mucus were constantly present in the stools. Parasites, frequently enclosing red blood cells, were, on several occasions, found in the freshly-evacuated feces. At autopsy the mucous membrane of the colon proved to be greatly swollen and congested, while a large amount of mucus covered it. Several ulcers, sometimes reaching to the muscular coat, were seen in the large intestine. Microscopically there was an acute inflammation of the mucous and submucous coats, with small areas of necrosis and hemorrhage in these situations. The infusoria were found, in great abundance, distributed through practically all of the coats of the intestinal wall, but were most numerous in the mucosa and submucosa. The author concludes that the balantidium coli must be regarded as the cause of certain diarrhœas. At first the organisms by their motion produce a diarrhœa from a mechanical irritation of the mucosa. Whether they are still motile after penetrating the wall of the colon is doubtful.

Finally, they give rise anatomically to a catarrhal or ulcerative colitis, but it is as yet uncertain whether the parasites alone are answerable for all the intestinal changes, or whether the schizomyces, also, have some part in the process. It is very probable that the balantidium reproduces in the intestinal wall. Since the infusoria may gain entrance into the bloodvessels, it is not improbable that they form emboli in the various organs, and especially in the liver and lungs. It cannot as yet be determined whether they produce the anatomical lesions principally through their mechanical action or through a chemical irritation.—W. T. L.

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**Further Observations on the Reaction of Bacillus Pestis in Plague.**—ROW (*British Medical Journal*, 1903, No. 2210, p. 1076) has investigated the factors concerned in the bacteriolytic properties of blood serum from convalescent plague patients. The serum when first removed is highly bacteriolytic for B. pestis, but either after heating at 56° C. for a few minutes, or after standing at room temperature for several days, the serum becomes entirely inactive. Fresh rabbit's serum, which in itself is not bacteriolytic for B. pestis, was added to the heated serum from convalescent plague

patients, and the mixture proved capable of destroying large numbers of B. pestis. The antipesteux serum of Roux was comparable to heated serum from plague convalescents, containing large amounts of immune body, but no complement. The author believing that the efficacy of the antipesteux serum was dependent upon its reactivation in the body by the complement of the individual, made experiments to determine the complement content of the blood of very ill or dying plague patients. It was found impossible to reactivate either serum from convalescent cases or the artificial immune sera by the addition of fresh serum from dying patients. Not only was this true, but the fresh serum appeared to have an inhibitory effect upon the action of fresh rabbit's serum, for when the fresh rabbit's serum and serum from dying plague cases were both added to immune serum, the reactivating power of the fresh rabbit's serum was annulled and the mixture became incapable of destroying B. pestis. The author concludes, that in cases dying of plague, the complement is not only decreased, but an anticomplement is formed. These results, he believes, explain the failure of the artificially prepared antiplague sera to affect the course of plague when given late in the disease.

## HYGIENE AND PUBLIC HEALTH.

UNDER THE CHARGE OF

CHARLES HARRINGTON, M.D.,

ASSISTANT PROFESSOR OF HYGIENE, HARVARD MEDICAL SCHOOL.

**Scarlet Fever, Diphtheria, and Aphthous Fever from Infected Milk.**—An outbreak of undoubted scarlet fever, due to infected milk, is reported by Ekholm (*Zeitschrift für klinische Medicin*, xlix., Nos. 1–4). Six families supplied with milk from the same source were invaded by the disease, and investigation showed that at the farm from which the milk was derived the milking was done by a milkmaid who, shortly before, had been treated for a phlegmonous angina. Another outbreak attributed, like the celebrated "Hendon epidemic," to diseased cows, recently occurred in Lincoln, England. All of the cases, forty in number, were patrons of a dairy at which the cows were found to be afflicted with a vesicular eruption on the teats and elsewhere. The majority of the patients were seized on the same day, the symptoms being sore throat, vomiting, and sometimes diarrhœa, with, in many cases, a scarlatiniform eruption on the third day, followed a week later by desquamation. In one household no less than fourteen persons were seized, but not one of them, or of the others who sickened, was seriously affected.

Five cases of diphtheria have recently been traced by Dr. A. K. Chalmers, M. O. H. for Glasgow, to milk from a farm conducted by a farmer whose throat was found to be affected with an abundance of B. diphtheriæ, but who at no time had had any definite symptoms of the disease, nor had considered

himself to be seriously ill. That the number of cases among his patrons was no larger was supposedly due to the fact that only occasionally had he personally milked the cows.

During the recent epidemic of foot-and-mouth disease in New England, Dr. E. F. Brush (*Journal of the American Medical Association*, June 20, 1903) found that at Concord, Massachusetts, where 327 cattle had been killed because of the disease, but one owner of the infected animals was a milk peddler, and his was the first herd in which the disease was discovered. Among his customers four persons were found who were ill: An old gentleman and his wife, with slight fever and nausea; their son, with mild aphthæ and herpetic eruption, and a middle-aged woman, with a very sore mouth and characteristic vesicular eruption of aphthæ. At Lawrence he found a family of five children, all of whom had aphthæ after drinking milk supplied by a dealer whose cows were shortly afterward condemned. Four of the children had sore mouth, although not very sick, but the fifth was very ill, with vomiting, diarrhœa, and fever. The tongue and lips were very much swollen and covered with blisters. After four days of sickness, convulsions appeared, but ceased when a change was made to another dealer. A case of the disease in a child, aged thirteen months, is reported by Josias (*Gazette hebdomadaire de Médecine et de Chirurgie*, June 1, 1902), who traced the trouble to a dairy where the disease existed among the cows.

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**Cigar Stumps and Tuberculosis.**—That stumps of cigars that have been smoked by consumptives can transmit tuberculosis immediately after they have been smoked, and even two weeks afterward if they have been kept in a dry place, has been shown by L. Peserico (*Archiv für Hygiene*, xliv. p. 189). If kept in a moist place they lose their infectiveness after about ten days, because it seems that the water dissolves something from the tobacco which destroys the virulence of the tuberculous organisms, although it does not take away their vitality. Examination of cigars as bought in the shops, with respect to the presence of the tubercle bacillus, gave no positive results. The content of germs in cigars and cigarettes shows that these are neither abundant nor very various. Moulds and potato bacilli are first in abundance, then come several species of proteus and pus cocci, the presence of which can explain several purulent affections for which smokers are sometimes inclined to blame their cigars.

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**Purification of Water in the Field.**—The requirements of any quick chemical method of purification of water are, according to Nesfield (*Public Health*, July, 1903, p. 601), certainty of effect; the imparting of no taste to the water; absence of any noxious chemical substances in the water; and adaptability to foreign travel—that is, the agents employed must be easily carried and not prone to change on keeping. By experiment he demonstrated that 0.125 g. of chlorine is sufficient to sterilize, within five minutes, a litre of water infected with broth cultures of B. coli, B. typhosus, and Shiga's dysentery bacillus. After the process of sterilization is completed the free chlorine can be removed by means of commercial sodium sulphite, the resulting compounds being sodium sulphate and hydrochloric acid, the latter in turn becoming

neutralized at once by the alkali present in the commercial sulphite. One hundred grams of chlorine will suffice to sterilize 176 gallons of water, and will require 177.46 grams of sulphite for neutralization. The gas can be stored in liquid form in lead-lined iron cylinders having a jet with a very fine capillary canal controlled by a tap. The sulphite may be made into tablets or cakes. For use in water-bottles, tablets containing 1.5 grains of bleaching-powder and 0.5 grain of sodium bicarbonate may be employed. These evolve nascent chlorine when placed in water, and will sterilize a pint of water within ten minutes. The chlorine and its resultant bad taste may be removed by a fourth of a grain of sodium sulphite, which he recommends to be used in the form of tablets coated with a film of gelatin, which will dissolve in ten minutes. The chlorinating and the sulphite tablets may be introduced together, the latter beginning to act when the former has served its purpose, and the water is thus made sterile and tasteless in fifteen minutes.

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**Disinfectant Properties of Corrosive Sublimate and of Alcohol.**—The practical value of corrosive sublimate in solutions of 1 : 1000, 1 : 5000, and 1 : 10,000 has been investigated by HARRINGTON and WALKER (*Boston Medical and Surgical Journal*, April 23, 1903, p. 435), who employed as test objects silk threads impregnated with bouillon cultures of B. typhosus, B. diphtheriæ, staphylococcus pyogenes aureus and albus, and B. coli communis, B. pyocyaneus, and B. anthracis. The threads were used in both the wet and dried state. Following are their conclusions: (1) Different species of pathogenic bacteria and different cultures of the same species vary very greatly in their resistance to the action of corrosive sublimate. (2) With some species resistance is diminished in a remarkable degree by a condition of dryness, so that even the 1 : 10,000 solution can bring about sterility in a very short time. But some species are not materially affected in this respect by dryness. (3) Corrosive sublimate in as weak solution as 1 : 5000 is ineffective against the common pathogenic bacteria, including the pus organisms, when they are moist, excepting after prolonged contact. Since fifteen minutes' contact is not sufficient for the destruction of B. coli communis, B. pyocyaneus, and staphylococcus pyogenes albus in the moist state, or of staphylococcus pyogenes aureus, whether moist or dry, the use of this and of weaker preparations in surgical work and for irrigation and similar purposes should be abandoned. (4) Corrosive sublimate in the 1 : 1000 solution is very slow in its action on some of the commonest of the skin bacteria, and, since under the most favorable conditions more than ten minutes' contact may be necessary for it to kill staphylococcus pyogenes albus, it should not be relied upon to any great extent to insure sterility of the hands or of instruments. The mere dipping of the hands for a few seconds into solutions of this strength can serve no useful purpose, but, on the contrary, can lead to much harm by inducing a false sense of security. In order to produce sterility of the hands through the use of this preparation, absolute dryness of the bacteria present would be essential; but a condition of the skin which would insure such dryness would also insure the bacteria not on the very surface against contact with the poison. (5) Corrosive sublimate in any of the strengths commonly employed is a much overrated disinfectant, and under

the best of conditions is so uncertain in its action that it would be of advantage to abandon its use altogether in surgery.

The same observers (Ibid., May 21, 1903, p. 548) studied the germicidal power of alcohol in various dilutions, namely, 15, 20, 25, 30, 40, 50, 60, 70, 75, 80, 85, 90, 94, and 99 per cent. against the same organisms, and came to the following conclusions: (1) Against dry bacteria, absolute alcohol and ordinary commercial alcohol are wholly devoid of bactericidal power, even with twenty-four hours' direct contact, and other preparations of alcohol containing more than 70 per cent. by volume are weak in this regard, according to their content of alcohol—the stronger in alcohol, the weaker in action. (2) Against the commoner, non-sporing, pathogenic bacteria in a moist condition any strength of alcohol above 40 per cent. by volume is effective within five minutes and certain preparations within one minute. (3) Alcohol of less than 40 per cent. strength is too slow in action or too uncertain in results against pathogenic bacteria, whether moist or dry. (4) The most effective dilutions of alcohol against the strongly resistant (non-sporing) bacteria, such as the pus organisms in the dry state, are those containing from 60 to 70 per cent. by volume, which strengths are equally efficient against the same organisms in a moist condition. (5) Unless the bacterial envelope contains a certain amount of moisture it is impervious to strong alcohol; but dried bacteria, when brought into contact with dilute alcohol containing from 30 to 60 per cent. of water by volume, will absorb the necessary amount of water therefrom very quickly, and then the alcohol itself can reach the cell protoplasm and destroy it. (6) The stronger preparations of alcohol possess no advantage over 60 to 70 per cent. preparations, even when the bacteria are moist; therefore, and since they are inert against dry bacteria, they should not be employed at all as a means of securing an aseptic condition of the skin. (7) Provided the skin bacteria in the deeper parts can be brought into contact with disinfectants, alcohol of 60 to 70 per cent. strength may be depended upon usually, but not always, to destroy them within five minutes.

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All communications should be addressed to—

DR. FRANCIS R. PACKARD, 1831 Chestnut Street, Philadelphia, U. S. A.